MARCH 30, 1959

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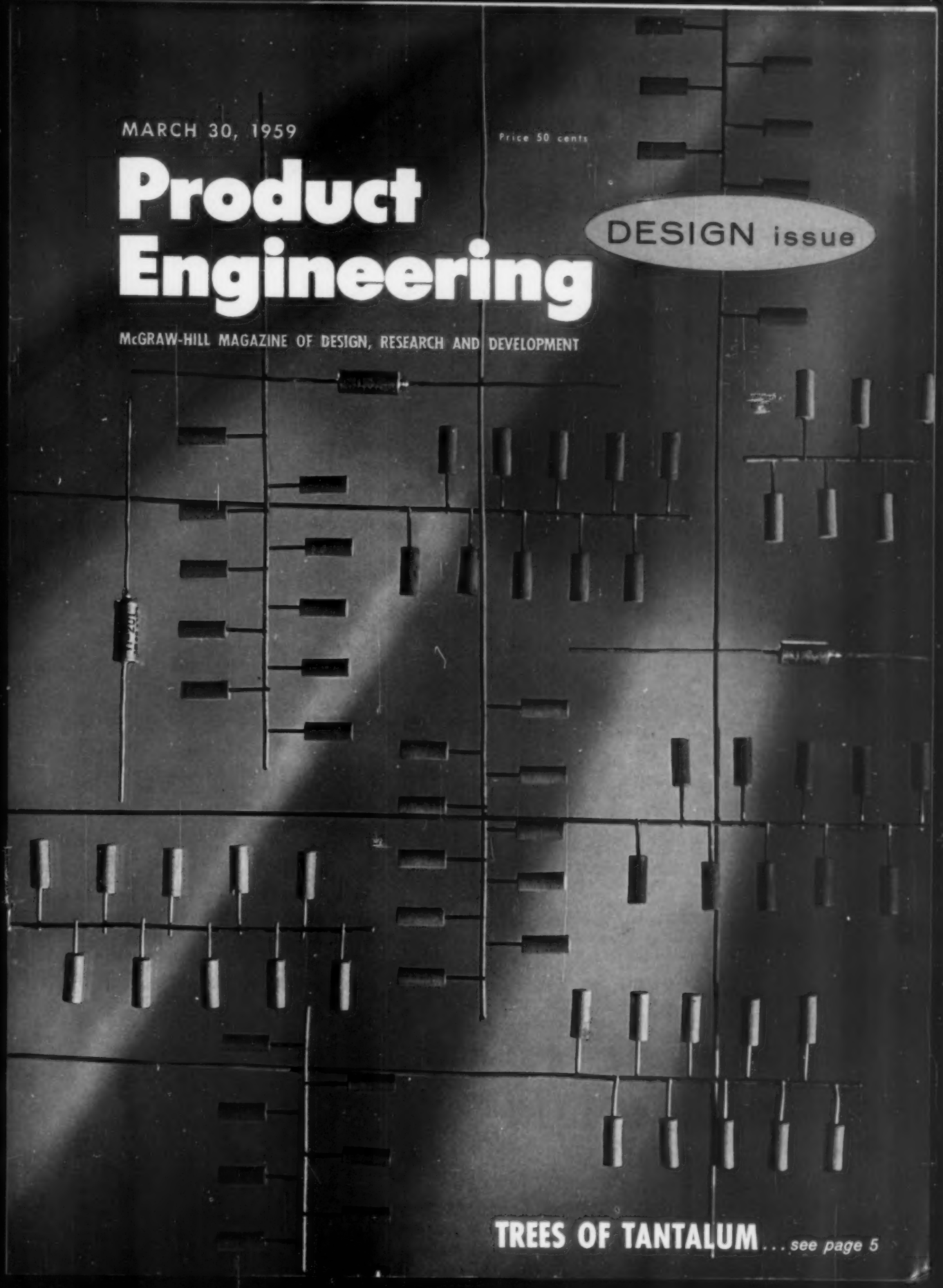
Product Engineering

DESIGN issue

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT



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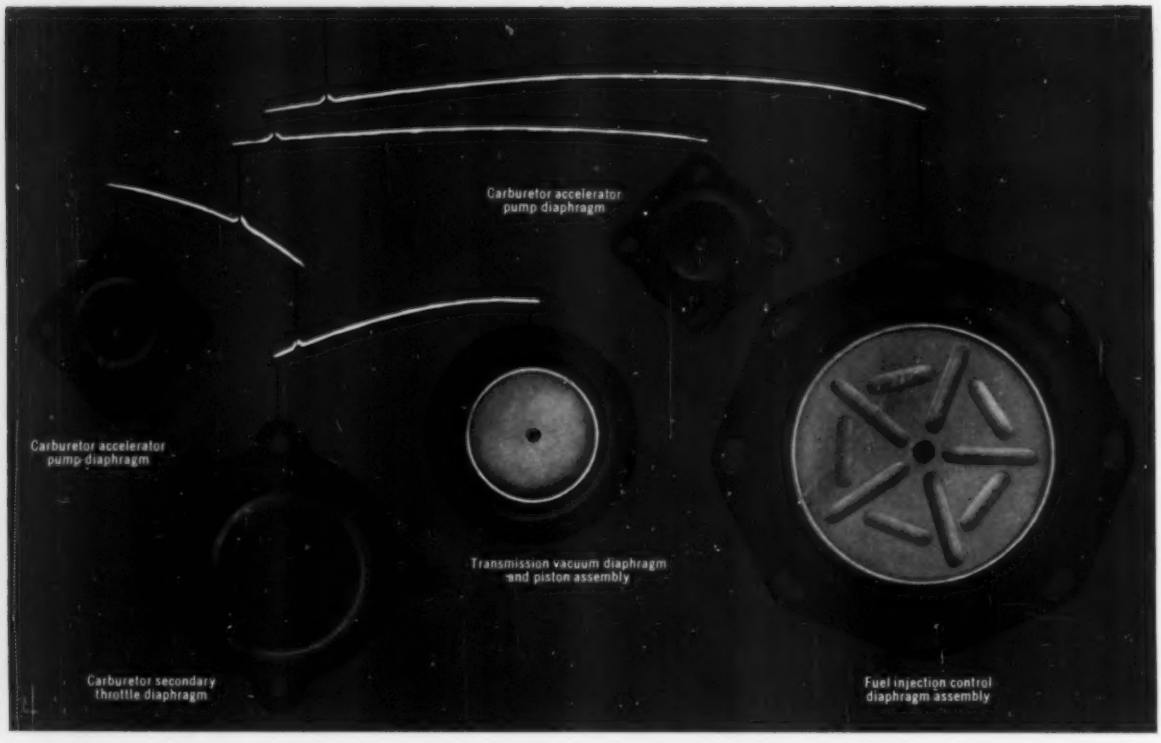
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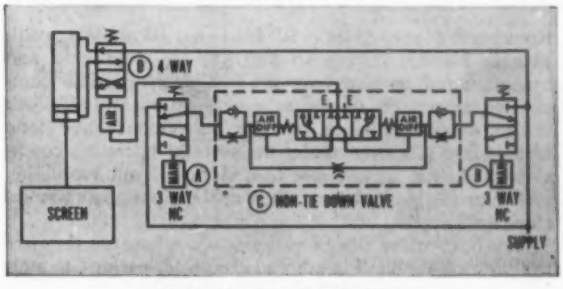

SEQUENCE OF OPERATIONS

- Operating valves "A" and "B" simultaneously permits air to flow through the valve "C", shifting valve "D". Valve "D" operates cylinder raising screen.
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- Operating either valve "A" or "B" independently will *not* cause valve "C" to pass actuating air to valve "D".
- De-actuating either valve "A" or "B" independently, causes pilot air to valve "D" to be exhausted through valve "C". After that occurs both valves "A" and "B" must be released to re-set valve "C" before it will pass air to valve "D" again.

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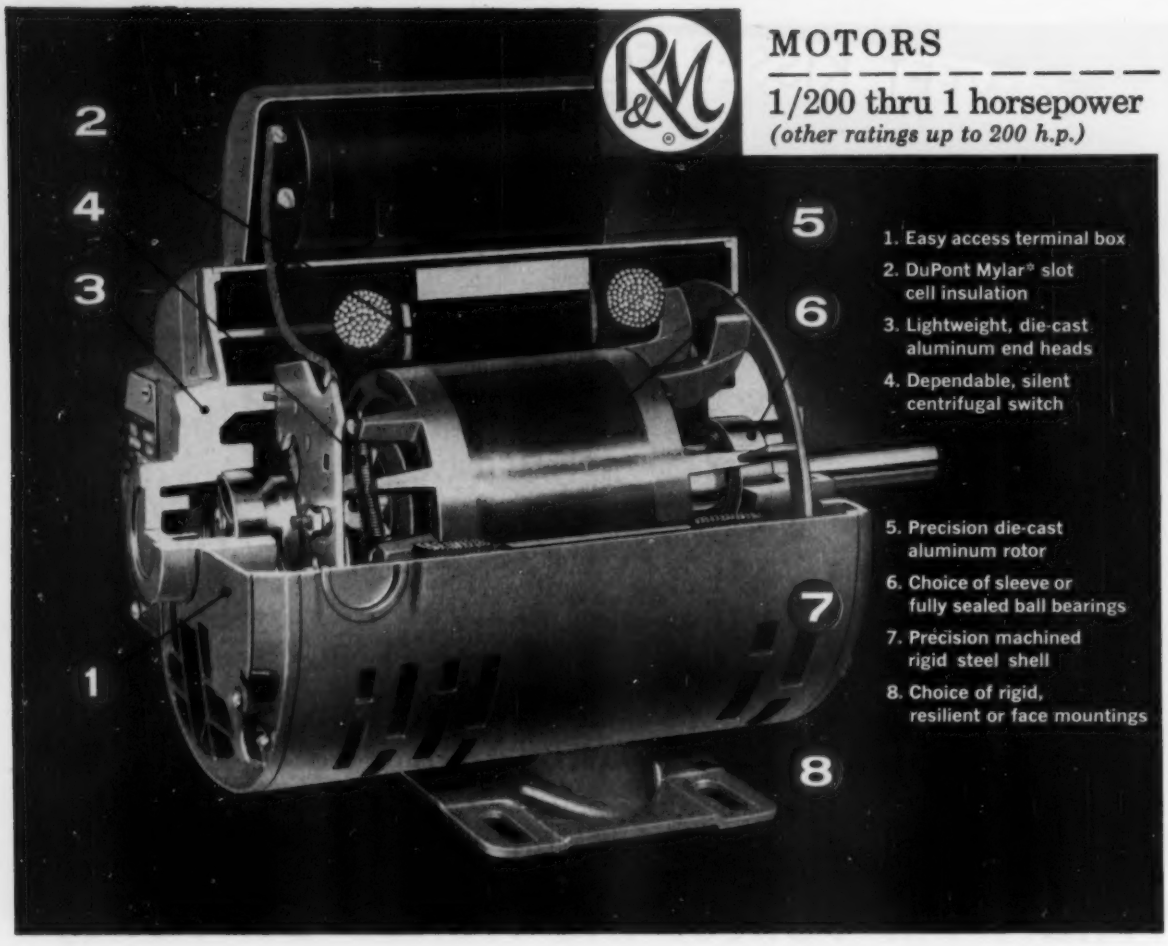
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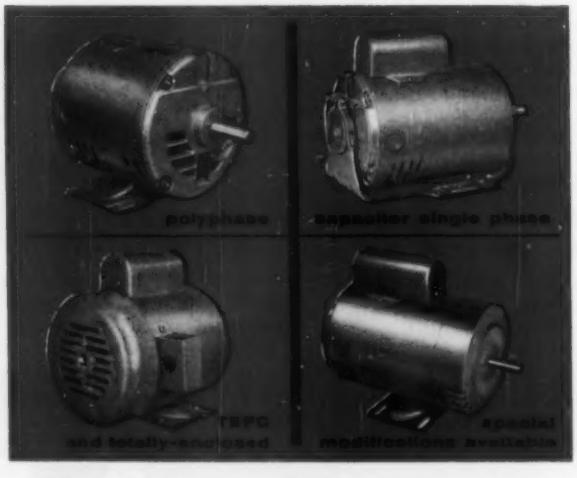

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Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

DESIGN issue

March 30, 1959 Vol. 30, No. 13

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Our detailed bibliography for the design engineer made a hit two years ago—and readers have bought thousands of reprints. It has now been brought up to date. The revised listing is broken down into these divisions:

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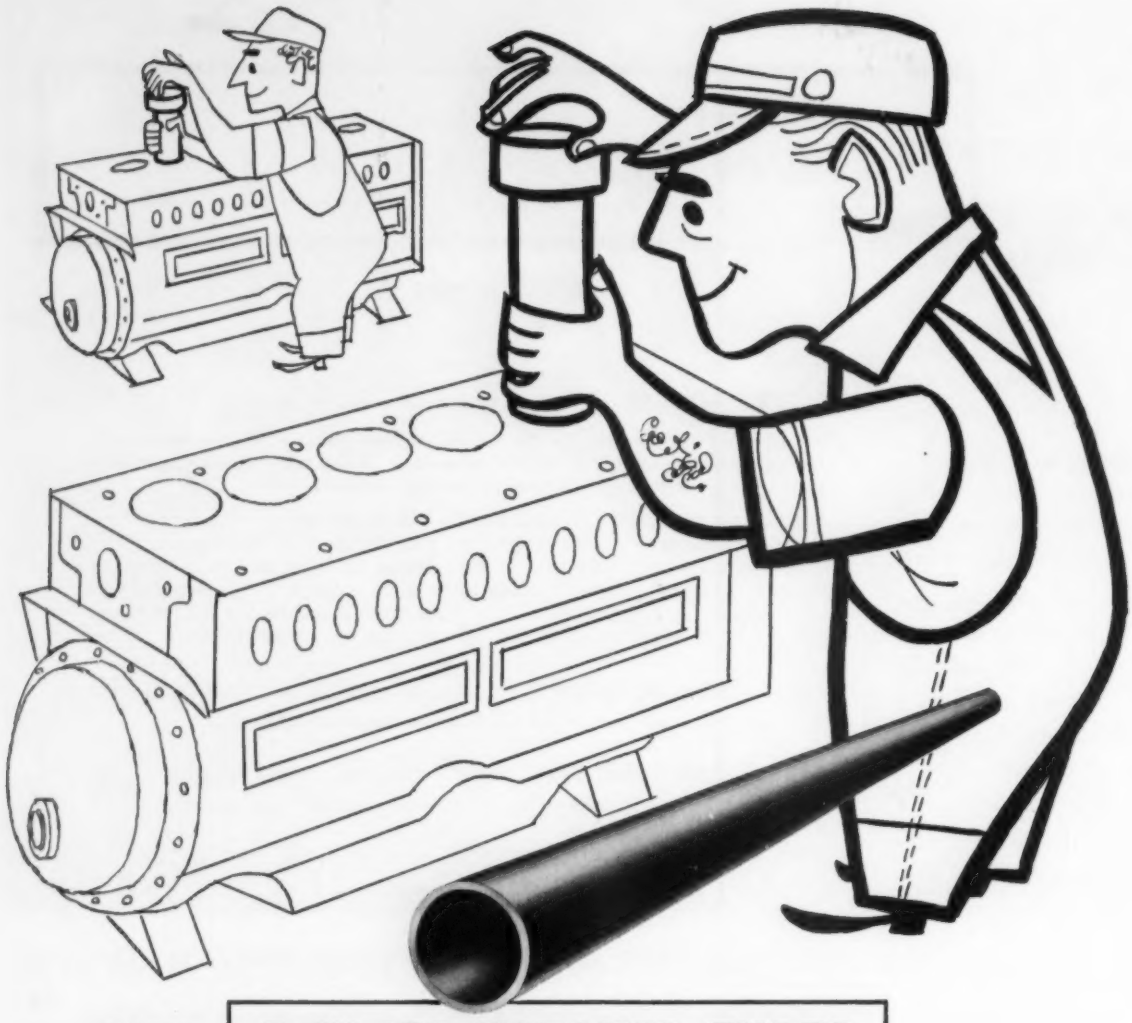

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Interesting to Note . . .

Tantalizing Tantalum

Greek legend tells us that a son of Zeus, a dashing young romantic named Tantalus, once abused the National Security Act of the Gods by smuggling secrets out of heaven and passing them on to mankind. He was duly convicted and sentenced to spend his days in the lower world. He had to stand up to his neck in water, which flowed away from him when he tried to drink. Over his head hung fruits which were just out of his grasp. Hence, our word "tantalize."

The Swedish chemist, A. E. Ekeburg, further immortalized Tantalus by naming our 72nd element after him. When Ekeburg discovered tantalum in 1802, he noticed it had an oxide which possessed acid properties. This oxide, he said, "when placed in acids is incapable of taking any of them up." A century later, the Siemens-Halske plant in Berlin produced small pellets of tantalum pure enough to work into metal filaments for lamps.

On our cover are tantalum pellets, arranged in a "tree" lattice for anodizing to form a dielectric film which makes them into capacitors. The resulting spectrum makes an interesting pattern when combined with the finished capacitors. These are "tan-TI-cap" capacitors made by Texas Instruments Inc, Dallas, whose Semiconductor-Components Div supplied us with the parts. Our own studio made a difficult photo first with plain black background. Then, feeling its oats, it shot the 3-D version against the rainbow.

Peter Cooper—Engineer-educator

With the cost of education getting higher each year, it might be appropriate to pause and observe the 100th anniversary of a school that has never charged a dime for tuition. Cooper Union, one of our first schools to give engineering courses, opened its doors to 2000 men and women in the fall of 1859, offering courses in mathematics, mechanical philosophy, chemistry, architectural drawing and some of the arts. From that day it has been maintained as a free school and has boasted such graduates as David Steinman, bridge-builder; Irwin S. Chanin, engineer-architect; Michael Pupin,

(CONTINUED ON PAGE 7)

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A McGRAW-HILL PUBLICATION

March 30, 1959 Vol. 30, No. 13

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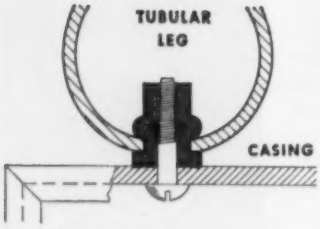
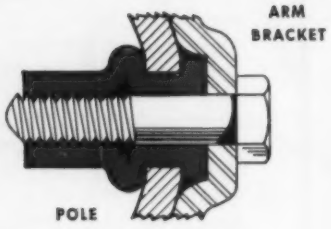
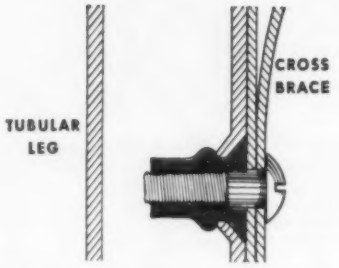


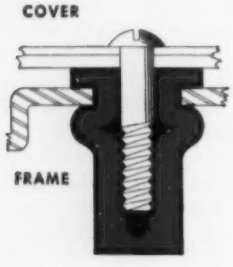
One man installs Rivnuts from one side in seconds—speeds assembly of *barbecues.* Permanent nutplates in legs save time in faster knockdown, too.



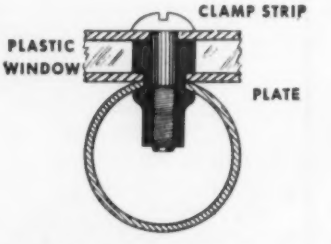
One man does the work of two, assembling arm brackets on *light poles.* Tests show pole or arm will fail before Rivnuts.



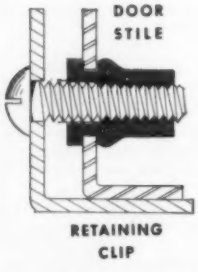
Clean, functional lines of modern *furniture* are preserved by Rivnuts. Upset inside tubular legs, they replace unsightly nuts, bolts and screws.



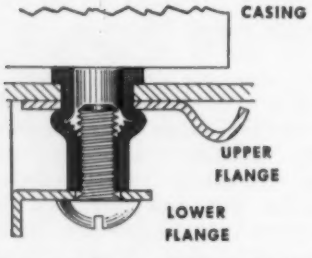
Rivnuts enable repair men to remove top of *automatic washer* and replace it easily. And Rivnuts can be installed after enamelling.



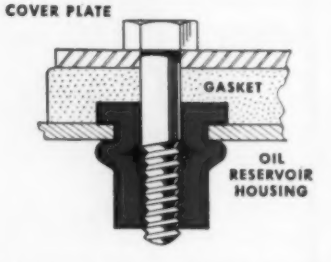
Upset Rivnuts secure *airplane window* plate to center post. Bulges in shanks seal out weather. Heads of Rivnuts serve as spacers for plastic window.



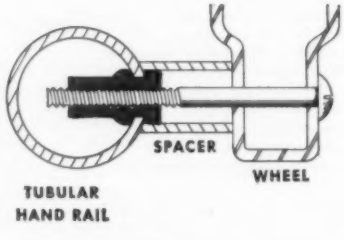
Rivnuts replace self-tapping screws used to hold retaining clips on aluminum *storm doors,* provide firm nutplates that won't loosen with shock or vibration.



Rivnuts eliminate need for reinforcing plates in *vaporizers.* In addition, Rivnuts space bottom flange automatically, prevent bending.



Assembly time for *oil reservoirs* is cut in half. Rivnuts eliminate welding, tapping and cleaning previously required to attach coverplate.



Wheel chair designers needed a blind nutplate with at least 6 clean threads. Rivnuts, only one-piece blind rivets with threads, were the answer.

Special fastening problems? B. F. Goodrich Rivnuts solve them. Send for free demonstrator. Dept. PE-39, B. F. Goodrich Aviation Products, a division of The B. F. Goodrich Company, Akron, Ohio.

B.F.Goodrich ***aviation products***

inventor; and Samuel Gompers, labor organizer. The school was conceived and built by Peter Cooper.

Cooper was born in lower Manhattan two years after the signing of our Constitution. He married early and in 1815 received his first patent—on a Rube Goldberg-type cradle for his first child. The cradle not only rocked itself but played a musical instrument and fanned flies from the baby. Income from the cradle was enough so that when Cooper was 30, he bought a glue factory for $2000. Soon he was making better glue than other manufacturers. His thinking was years ahead of his time—he firmly believed that R & D was the heart of any manufacturing enterprise. Following this philosophy, his glue factory soon produced isinglass from fish bladders at 75 cents a pound in competition with the Russian import costing $4. His wife helped by originating the recipe for a table gelatine known throughout the world today as Jello.

Tom Thumb gets in the act

Cooper was a hard man to hold down. After seven years in glue he had amassed $125,000; now he began looking for a new business venture. He found it by buying land in Baltimore. That city anticipated a boom from construction of its first horse-drawn railroad, the B & O, which, when completed the following year, ran from Baltimore to Ellicott's Mills, Md. On the eve of its opening, however, news was received from England that a steam locomotive had been successfully run. But then it was learned that steam engines could never be used on the existing B & O road because its curves were too sharp. This caused Cooper's B & O interests to look gloomy. Property values plummeted and, faced with a serious financial problem, he told the B & O directors that he would build them a steam locomotive to negotiate the curves.

Within two years, Cooper built the Tom Thumb, using musket barrels for tubing when he couldn't obtain pipes to connect the boiler to the engine. Two days after this locomotive was successfully put into operation, it lost a race with a horse-drawn coach when the blower-band slipped off its drum (*PE—Feb* 17 '58, p 5). Regardless, the day of the steam locomotive had been inaugurated in the United States.

Realizing that America was entering an age of machines, the sinews of which would be iron and steel, Cooper sold his Baltimore land interests at a big profit and bought the Trenton Iron Co. Money made money and at the age of 61, Cooper, now a millionaire, announced plans for establishment of the "Union of Science and Art." He had already accumulated land in Manhattan; all that now remained was designing and constructing his dream.

First air-conditioned auditorium

Always the engineer, he decided on wrought iron beams. Cast iron had been used for 25 years; wrought iron for a building the size of Cooper's Union was still unheard of. Fortunately, Cooper owned his own iron works so he could order his plant to roll beams twice as deep as had been previously attempted. This type of beam is now common in our skyscrapers.

Cooper had other engineering concepts he applied to the building. To enter its Great Hall, which through the years echoed the voices of such great Americans as Lincoln, Twain, Emerson and Thoreau, one had to walk down a flight of stairs. The logic behind this was obvious—in case of fire or panic, fewer people would be hurt going upstairs than rushing down. Another innovation was the huge steam-operated fan beneath the floor. It blew cool air up through hundreds of small vents beneath the seats. (Note fan-selection article on page 67.) This forerunner of modern air conditioning is still in operation, although the steam engine was replaced long ago by an electric motor.

The Great Hall was not the only amazing sight for those visiting the new building. A big, round hole extended from the basement to the roof. "At the time," wrote Edward Hewitt, Cooper's grandson, "there were no passenger elevators but Mr. Cooper insisted on putting in the elevator shaft. He said that if there were no passenger elevators when the building was ready, he would build one. As there were none available, Edward Cooper, his son, designed a special steam engine with the appropriate winding drums for the rope." It ran until 1914 when it was replaced by an electrically driven car.

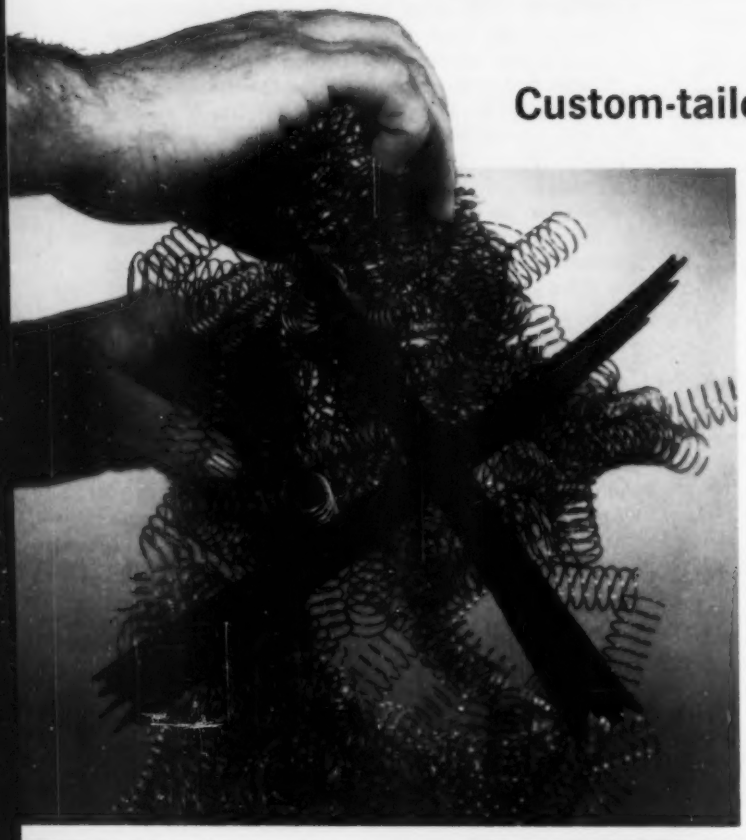
Engineer's bookshelf—100 years ago

When the Union opened its doors, there were no technical publications as we know them today. Newspapers and books were the primary source of scientific information. Cooper Union's free reading room, the first in New York, became a haven for young and old eager to learn about the world's latest technological developments. In the mid-19th century, only the well-to-do could afford building a personal library like the one discussed on p 45. Many a successful engineer and businessman can say he browsed and studied in the same Cooper Union room with a Bowery bum reading the morning papers on one side of him and a Felix Frankfurter or Samuel Gompers on the other.

The Union just last month announced the construction of a new $4-million engineering building to include the latest facilities for work in electronics and atomic energy. If Cooper were living today, the new building would undoubtedly contain some of the same strange innnovations that led his contemporaries to brand his building a folly, and his engineering design "impractical."

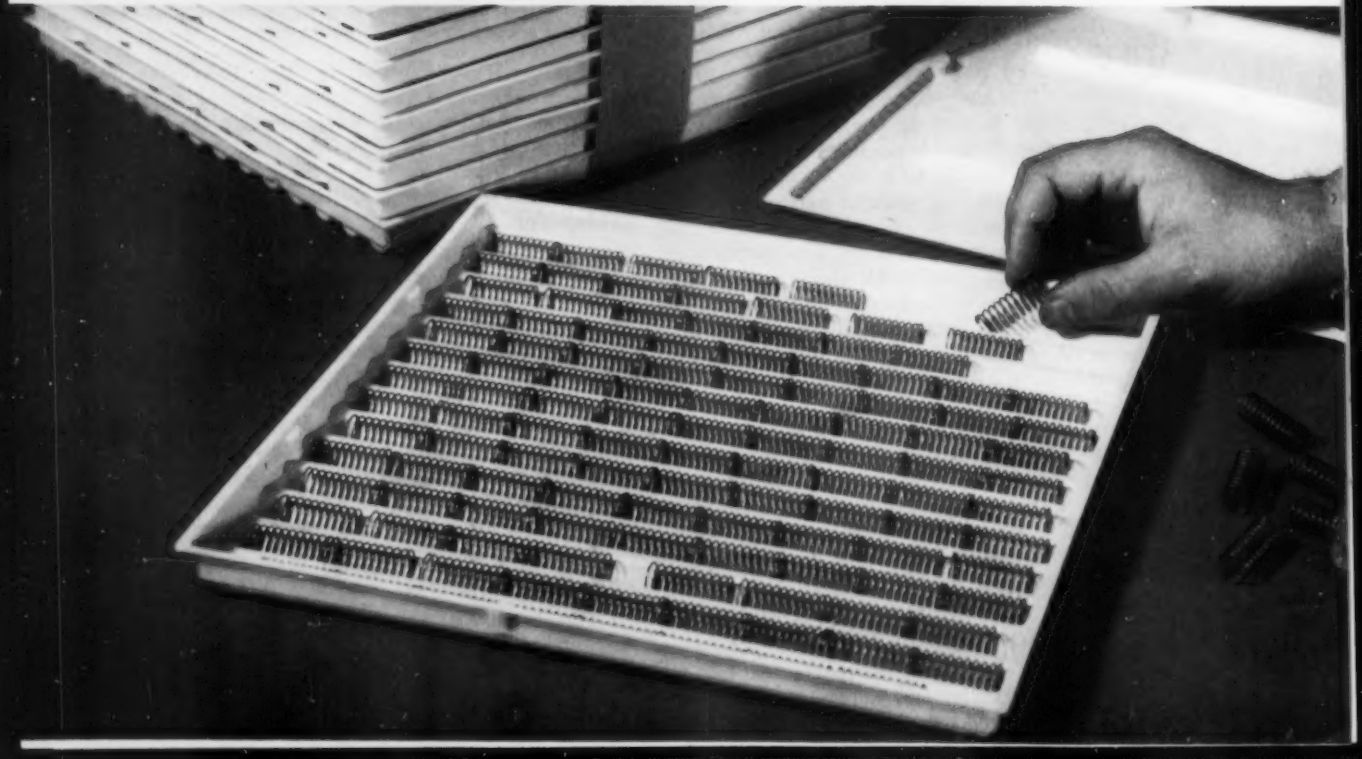
—Benedict A Leerburger Jr

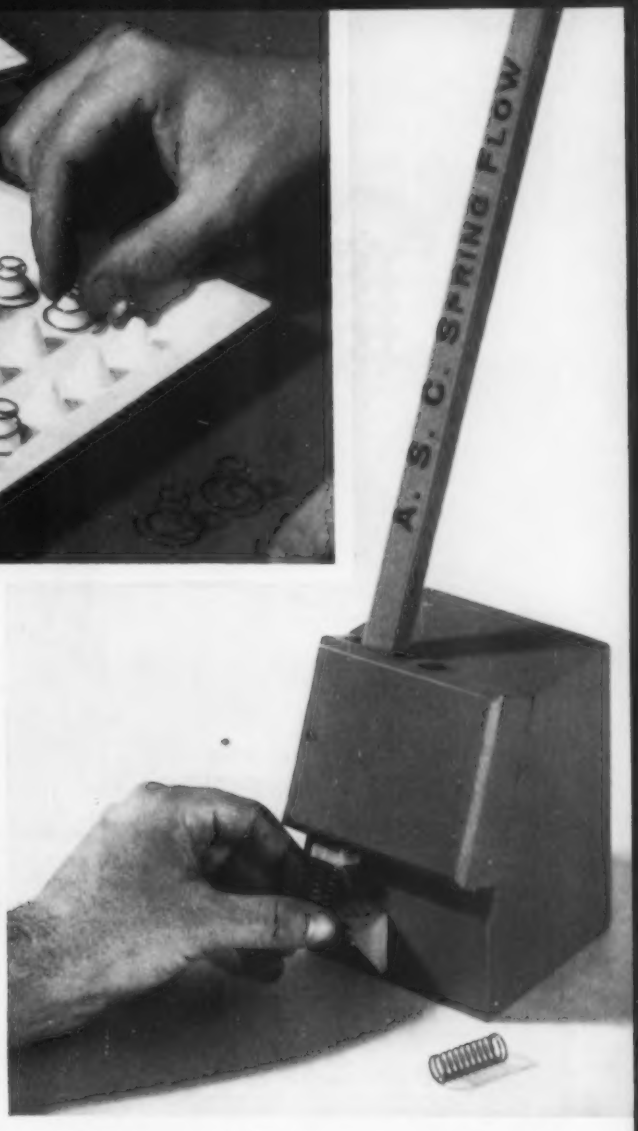
NEW... Spring Flow®



Custom-tailored packaging of springs that cuts costs and speeds operations in your plant

Spring Flow is a systematic approach to the problems of handling and storage of springs, wire forms, small stampings, in customer plants. It overcomes time-wasting tangling, and the distortion that often results from tangling. It can be engineered for specific applications to expedite hand or automatic assembly.





Spring Flow lowers handling and assembly costs—eliminates distortion—protects finish

Spring Flow makes use of a variety of modern materials, dispensers, containers. The extent to which it may be applied depends on the complexity of each individual part and handling requirements. The cost of Spring Flow is frequently offset by resulting savings.

The potential benefits of Spring Flow almost defy imagination. Ask for a Spring Flow proposal for your springs or other fabricated-metal products. Or find out more about this exclusive service by writing for the new booklet—"Spring Flow."

Associated Spring Corporation

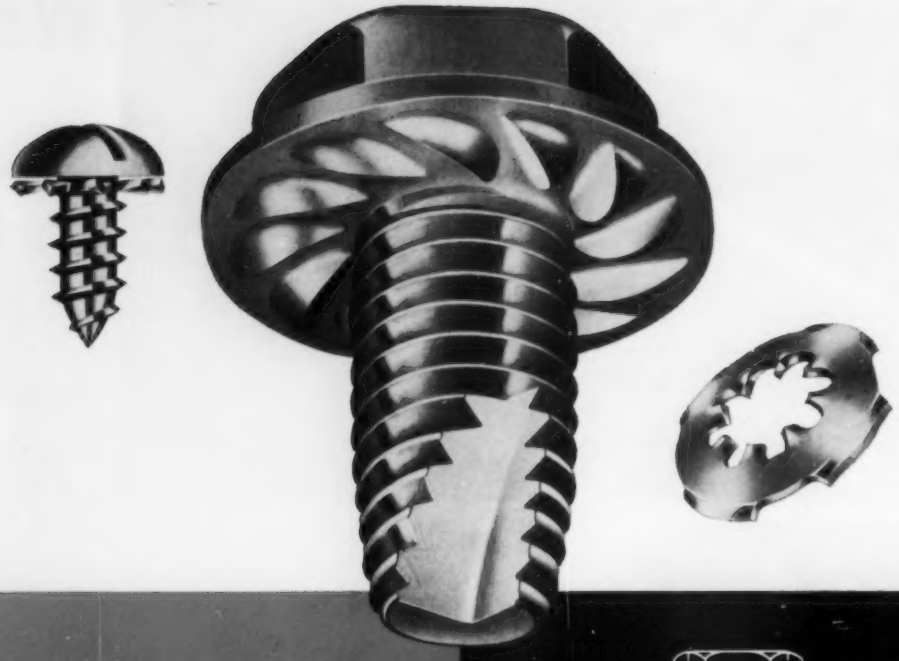
General Offices: Bristol, Connecticut

Wallace Barnes Division, Bristol, Conn. and Syracuse, N. Y.
B-G-R Division, Plymouth and Ann Arbor, Mich.
Gibson Division, Chicago 14, Ill.
Milwaukee Division, Milwaukee, Wis.
Raymond Manufacturing Division, Corry, Penna.
Ohio Division, Dayton, Ohio
F. N. Manross and Sons Division, Bristol, Conn.
San Francisco Sales Office, Saratoga, Calif.
Seaboard Pacific Division, Gardena, Calif.
Cleveland Sales Office, Cleveland, Ohio
Dunbar Brothers Division, Bristol, Conn.
Wallace Barnes Steel Division, Bristol, Conn.

Canadian Subsidiary: Wallace Barnes Co., Ltd., Hamilton, Ont. and Montreal, Que. Puerto Rican Subsidiary: Associated Spring of Puerto Rico, Inc., Carolina, P.R.

CIRCLE 105 READER SERVICE CARD

5808



HOW TO SELECT
COST-SAVING

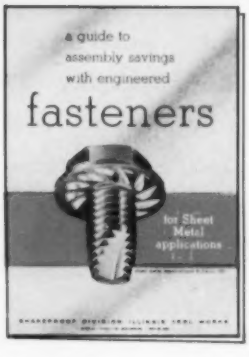
fasteners for sheet metal

A TYPICAL EXAMPLE:
How to Avoid Stripping—

*When high stripping torques are required, a Shakeproof NIBSCREW® should be used. "Nibs" under the head take up excessive driver torques and eliminate loose screws, re-work and repair.

You can realize important savings on your assembly line by specifying fasteners that eliminate operations, speed up production and assure highest quality. Engineered Fasteners by Shakeproof now overcome stripping, provide sealing, assure maximum locking and solve countless production problems encountered in mass assembly of products using sheet metal.

SEND FOR NEW SHAKEPROOF BULLETIN NO. 100!
Illustrates twelve typical examples of cost saving fasteners for sheet metal applications. Describes important "check points" for fastener selection. Offers testing samples. Write for your copy today!



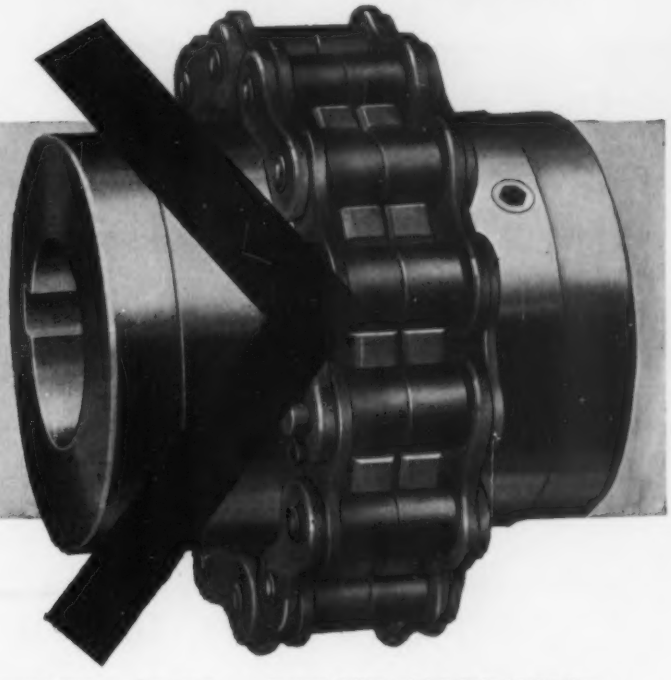
SHAKEPROOF
"FASTENING HEADQUARTERS"®
DIVISION OF ILLINOIS TOOL WORKS
St. Charles Road, Elgin, Illinois
In Canada: SHAKEPROOF/FASTEX
Division of Canada Illinois Tools Limited, 67 Scarsdale Road, Don Mills, Ontario

Why LINK-BELT "RC" Couplings mean

Reliable Connections

The difference is in the

DIVIDED ROLLERS



They're available in finished bore sizes up to 4 15/16 inches

SIMPLICITY . . . low cost . . . dependability—Link-Belt "RC" flexible couplings meet every requirement for economical power transmission. Unique divided roller design provides independent contact with each coupling half—equalizes load . . . maintains proper balance at high speeds . . . effectively compensates for shaft misalignment. In addition, these couplings are *all-steel*—precision-made and hardened for reliable long life.

See your local Link-Belt office for complete information on the wide range of bore sizes for shafts up to 12 in. Ask for Folder 2363.

Your choice of housings

STYLE R revolving housing, spun metal, vertical split.

STYLE P revolving housing, plastic, horizontal split.

STYLE S stationary housing, fabricated steel.

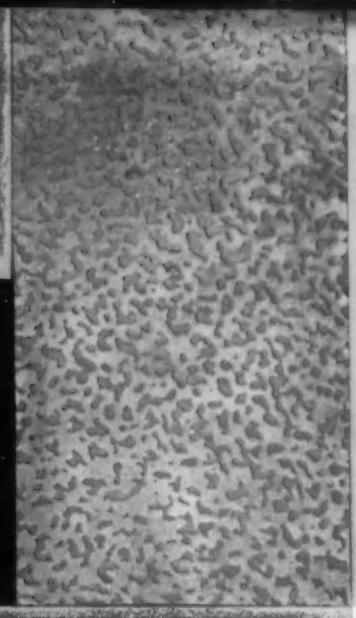
LINK-BELT

"RC" FLEXIBLE COUPLINGS

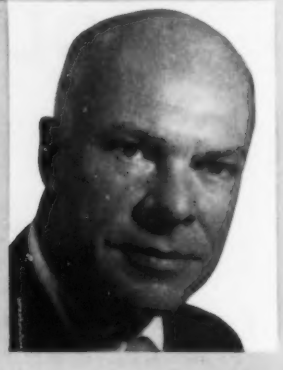
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,487

CIRCLE 107 READER SERVICE CARD

CIRCLE 108 READER SERVICE CARD →



Peter Schladermundt, A.I.A., A.S.I.D., P.D.C., for 25 years a leading designer of many of America's foremost industrial products. Formerly associated with Norman Bel Geddes and other designers and architects on such projects as General Motors "FUTURAMA" and the design of Rockefeller Centre. Presently heading his own firm specializing in all types of design service to industry. Recently designed the Trade Fairs for the United States Government Department of Commerce in Milan and Paris.



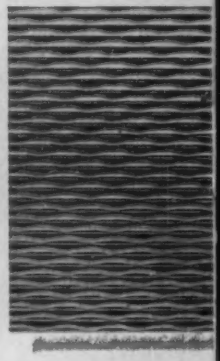
Peter Schladermundt and Sharonart combine for a new design concept....

Tomorrow's business machines will have the low, sleek profile and functional beauty you see in this typewriter design created by the nationally known industrial designer Peter Schladermundt especially for the Sharon Steel Corporation.

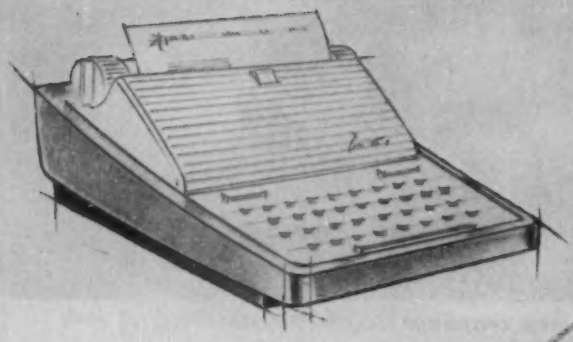
Gone is the bothersome cloth cover and in its stead a regular built-in secretarial workshop that includes typewriter accessory and lighted shorthand book and note compartments. And when the day is through the desk area is made neat by simply dropping the attractive machine lid.

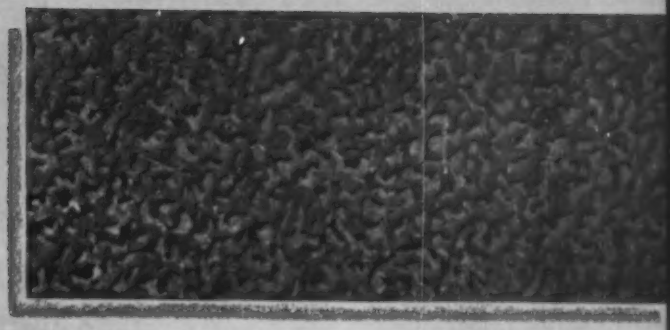
Ingenious? Yes, but perhaps the most important aspect of the design is the functional use of Sharonart, Sharon's popular patterned steel. By fashioning the work areas of Sharonart the usual marks of wear never show, and by forming the cover of this amazing metal many styles are immediately available to the manufacturer by simply changing the pattern . . . and here, too, wear is practically eliminated.

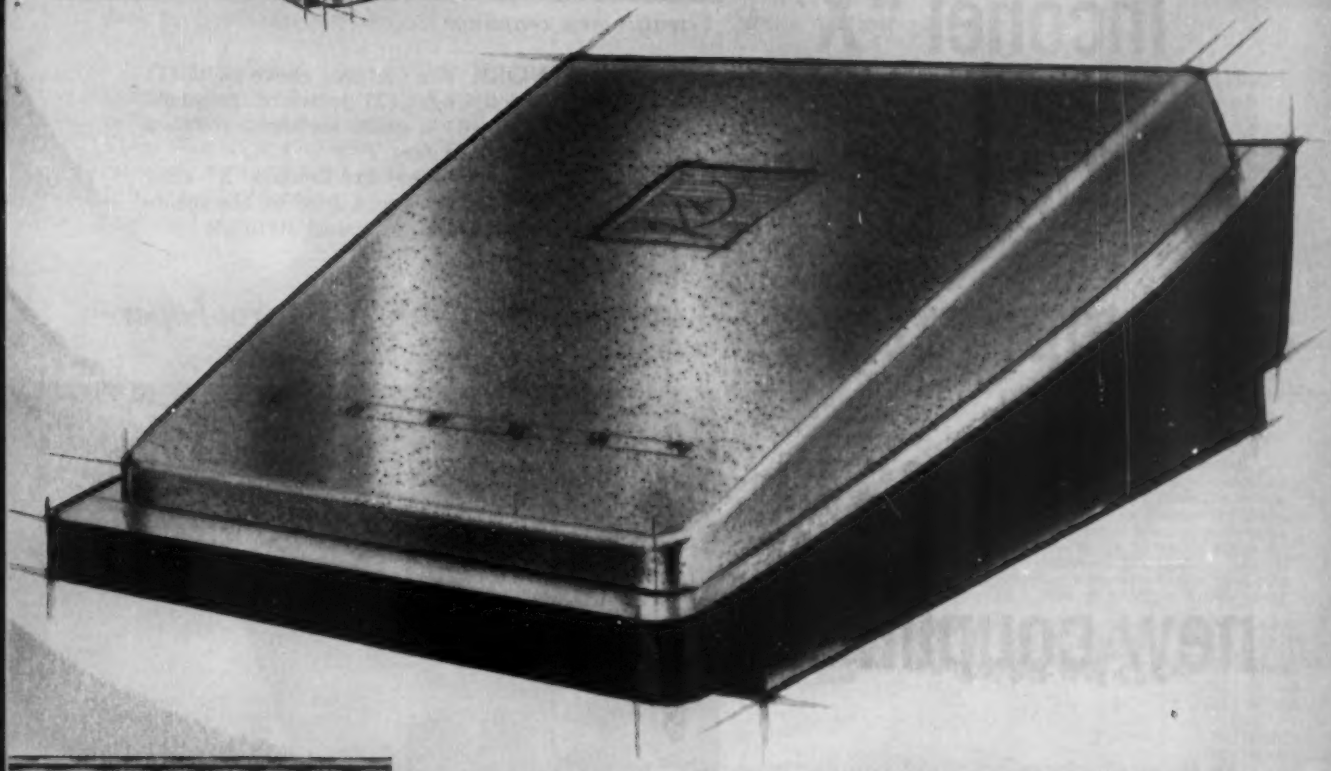
It's the kind of forward thinking that has made Sharonart the most popular material of its kind. Literature and information available from the Sharon salesman in your area or by writing direct to *Sharon Steel Corporation, Sharon Pa.*

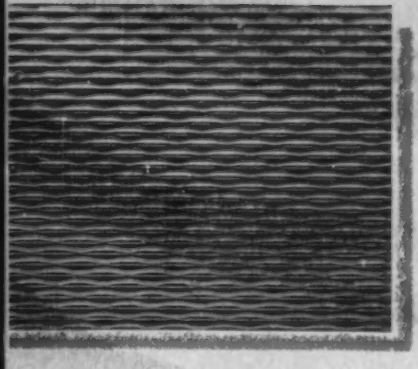


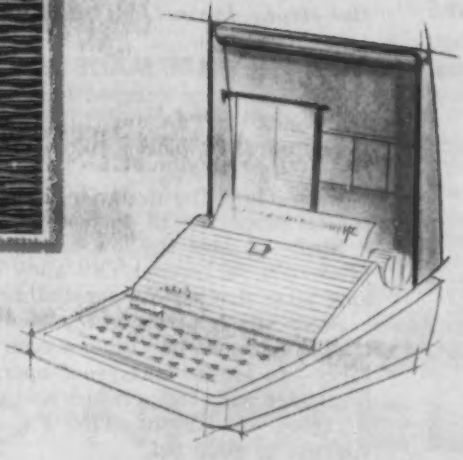
SHARONSTEEL **SHARON** *Quality* **STEEL**

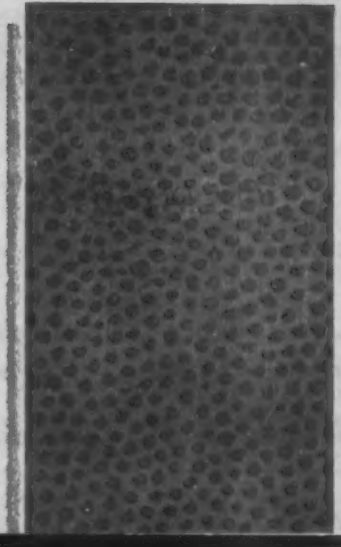








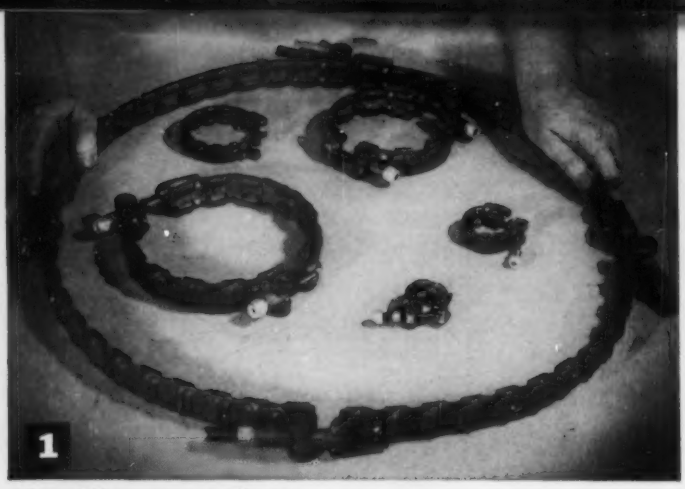




"fingers" of hot-strong Inconel "X" grip harder as temperature rises in new couplings

As these quick-on, quick-off couplings for high pressure or high vacuum lines get hot, Inconel "X"* age-hardenable nickel-chromium alloy "fingers" grip harder and harder, seal tighter and tighter. Couplings weigh and cost less than bolted flanges.

For detailed information on the Temperature Compensating Couplings described in this advertisement, write the manufacturer, D.S.D. Manufacturing Company, Hamden, Conn.



Versatile new couplings...

HOW THEY WORK The pictures above show (1) several completed couplings; (2) details of the quick-on, quick-off clamp; (3) a cross section through a pair of one coupling's "fingers".

Notice these "fingers". They are Inconel "X" alloy curled into a tight semicircle and lined on the inside with Nickel-containing stainless steel strip.

Alloy helps insure leak-proof oper-

Hot-strong Inconel "X" tabs...

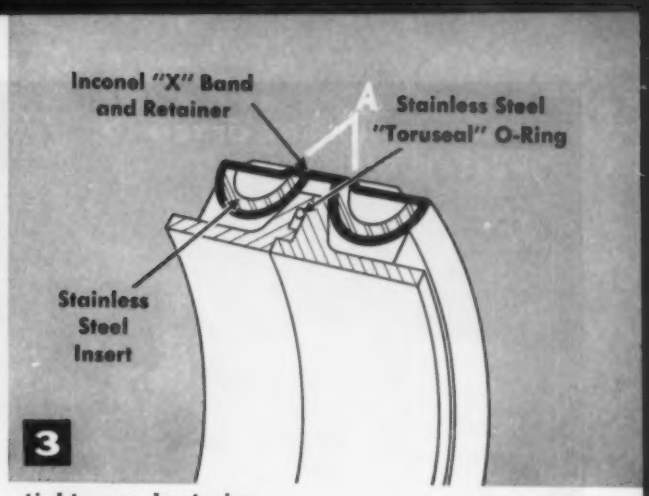
HOW THEY ARE MADE The pictures immediately above show (4) a stamped and partially bent Inconel "X" band; (5) "fingers" fully formed with stainless steel inserts in place; (6) "hot" test fixture with typical test results.

Notice how the designer takes advantage of the special properties of Inconel "X" alloy.

First, he uses the low expansion and low creep properties of Inconel "X" alloy to limit short and long term changes in overall dimensions.

Second, he depends on the superior spring properties of Inconel "X" alloy – even at high temperatures – to assure leak-proof operation of the couplings over wide temperature and pressure conditions ... from −320°F to +1750°F ... from 0.8 microns vacuum to 8000 psi.

lock and release quickly...



tighten as heat rises...

"Fingers" work like a bimetal... uncoiling as temperature goes up to grip harder and harder. As temperature drops, "fingers" recoil... up to a point. Then shoulders (A) stop the "finger" motion. Even sub-zero temperatures make no further change in initial sealing tension.

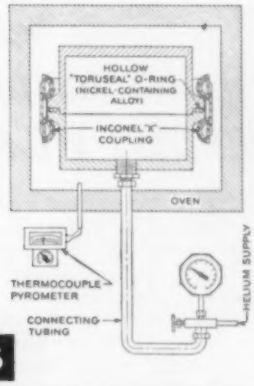
Initial sealing tension is obtained by tightening Inconel "X" T-head clamp-bolts (one to four, depending on coupling diameter). Seal is established by hollow "Toruseal"** O-Rings... usually made of Nickel-containing Type 321 stainless steel or of Monel* nickel-copper alloy.

*Registered trademark
**T.M. of D.S.D. Manufacturing Company
The International Nickel Company, Inc.

ation from −320° to +1750° F and from 0.8 microns vacuum to 8000 psi

curled into bimetal "fingers"...

TEST ASSEMBLY AND RESULTS FOR TEMPERATURE COMPENSATING COUPLINGS



Test assembly shown left provides more severe conditions than ordinary operation where couplings are exposed to cooler ambient temperatures. Temperatures are for entire assembly, including gas in duct. Test assemblies were held at heat long enough to attain steady state.

Coupling Size, in.	Temperature, °F	Pressure Lbs	Results
1½	−90	300-245	No leak
1½	70	1830	No leak
3½	1000	201	No leak
3½	1100		
	1200	76	No leak
6½	70	200	No leak
6½	70	high vac	No leak
7	750	50	No leak
7	70	150	No leak

prevent leaks in most environments

Third, he takes advantage of the ductility of Inconel "X" at sub-zero temperatures to extend the useful temperature range of the coupling down close to absolute zero.

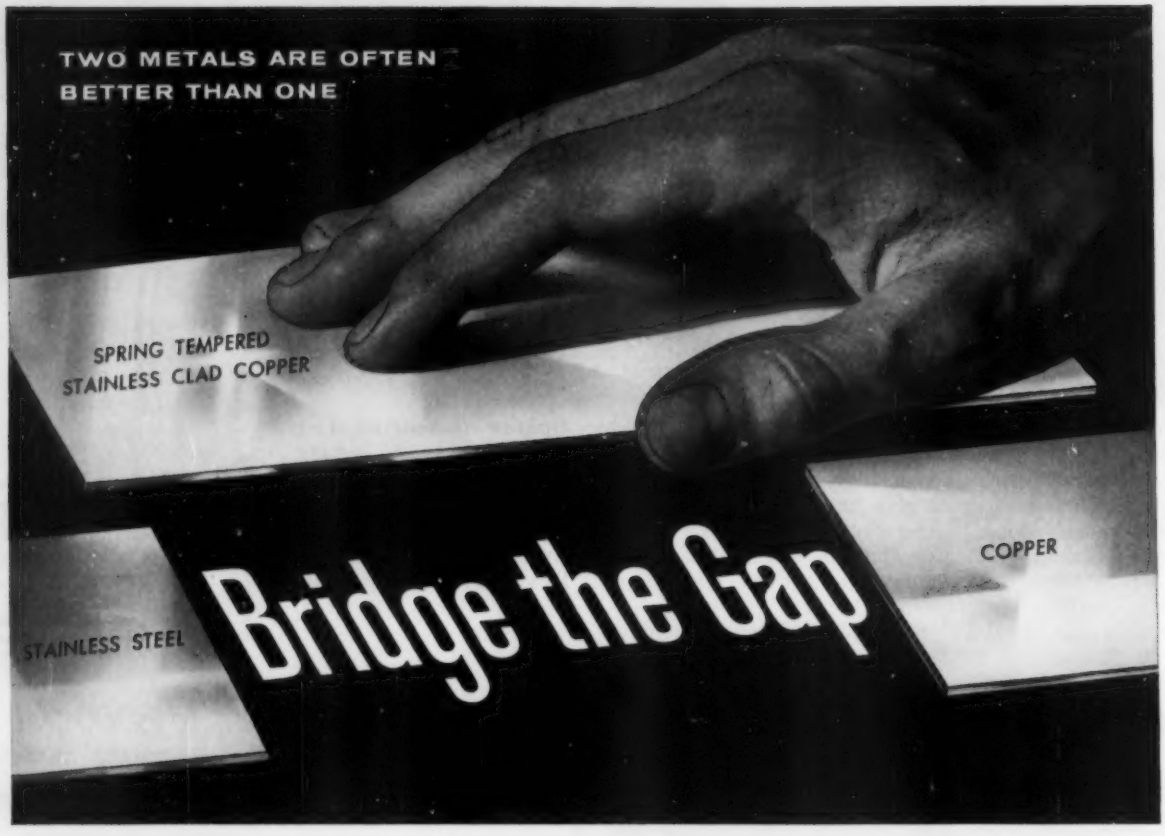
Fourth, he counts on the outstanding corrosion and oxidation resistance of Inconel "X" alloy to prevent scaling of "fingers" and eating away of threads.

MANY INCO NICKEL ALLOYS OVERCOME EXTREME CONDITIONS Inconel "X" alloy is one of a group of Inco Nickel Alloys which have been developed to provide specific combinations of properties for high temperature use. If you are developing devices that require high strength and oxidation resistance at extreme high temperatures, one of these alloys may provide the exact combination of properties you need.

To learn more about these alloys, some of which have not yet been publicized, write us for a set of data sheets on new high temperature alloys. We'll also send you a copy of our booklet, "High Temperatures Spur Use of Nickel-Base Alloys."

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO NICKEL ALLOYS



... between the Limitations of Single Metals with

GENERAL PLATE CLAD METALS

The performance of a single metal will go so far . . . *but frequently not far enough.* And to bridge the gap between the limitations of single metals and the desired results, clad metals are used to obtain the requirements, or to do the job better . . . often at lower cost. That's why manufacturers of all types of products turn to General Plate for recommendations on their metal requirements. For instance . . . for electrical spring manufacturers, General Plate has developed:

Bronco*, phosphor bronze double-clad on copper to provide higher electrical conductivity without increasing cross-sectional area of spring blades.

Conflex* hardenable steel clad on one or both sides with sheet copper to obtain a superior spring material with better electrical conductivity and greater strength — at lower cost — than comparable copper alloys. And the copper surface is excellent for electroplated finishes.

Spring Tempered Stainless Clad Copper for spring blade service in applications requiring high electrical conductivity and excellent resistance to various types of corrosion.

If you are seeking metals with useful characteristics that can't be found in a single metal or alloy, investigate clad metals. If you want stronger or lighter components — or better electrical and mechanical properties — or fewer corrosion problems — or if you are interested in conserving critical metals or reducing parts costs, you can profit by using General Plate Clad Metals.

Write for a General Plate catalog today. Or better yet, why not talk over your requirements with a competent field engineer. His knowledge of the applications of clad metals is yours for the asking. No obligation, of course.

*Reg. Trade-Mark U.S. Pat. Off. and Foreign Countries

You Can Profit with General Plate Products . . .

METALS & CONTROLS CORPORATION

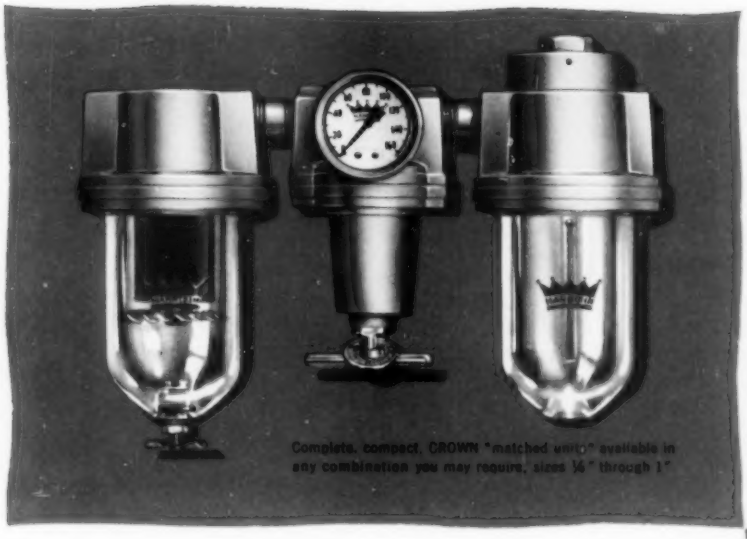
General Plate Division

1003 Forest St., Attleboro, Mass.

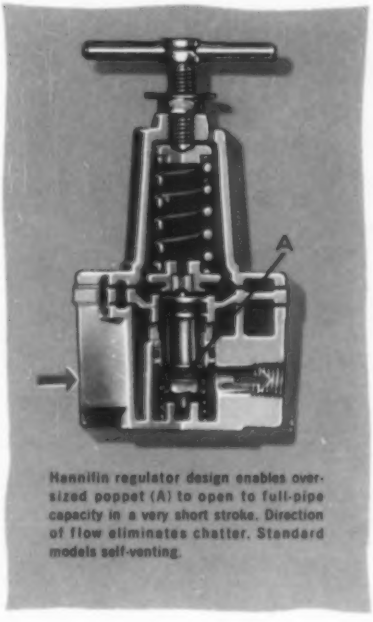
FIELD OFFICES: NEW YORK • CHICAGO • DETROIT • INDIANAPOLIS • MILWAUKEE • PASADENA

Circle 110 for FILTERS, 111 for Fittings→

From HANNIFIN *Crown* air preparation units that don't waste air power



Complete, compact, CROWN "matched units" available in any combination you may require, sizes ¼" through 1"



Hannifin regulator design enables oversized poppet (A) to open to full-pipe capacity in a very short stroke. Direction of flow eliminates chatter. Standard models self-venting.

Hannifin CROWN "Combo" units – filters, regulators and lubricators in any combination – keep compressed air in the "pink of condition" without depriving you of needed air flow.

Crown regulators open fast on demand, close precisely when demand is satisfied, deliver the exact amount of air needed. Their "piston balanced" poppet design, which makes possible a flat, large-area, poppet-type valve with very short stroke, is the reason. The inherent stability of this design – no hunting or chatter – results in multi-million cycle life.

Crown filters have large, reusable filter elements for minimum resistance to air flow. Crown lubricators introduce predetermined amounts of oil into the air stream, automatically. Their design is so responsive to variations in air flow rate that the concealed, tamperproof adjustment is rarely used. This is the easiest lubricator of all to fill, and remote-fill models are available.

Crown units are competitively priced and stocked in principal industrial areas by Hannifin CROWN authorized distributors. For CROWN literature and the name of the distributor nearest you, write:

HANNIFIN COMPANY

535 South Wolf Road • Des Plaines, Illinois

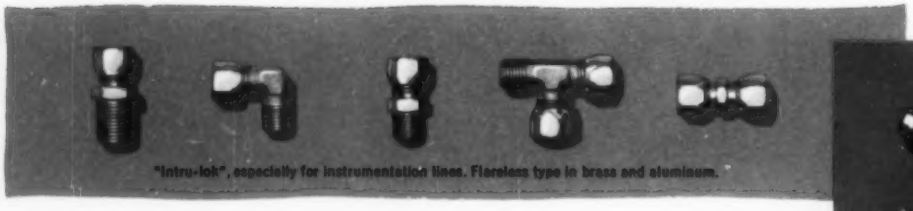
Lubricator bowl (A) is factory pre-set for most applications. Valve (B) shuts off air pressure to bowl when fill plug is removed. This patented Hannifin feature permits bowl refill without shutting down air line.

PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS

"Triple-lok", the "industrial standard"... in brass, stainless steel, aluminum, and cadmium plated steel. For flared tubing.

"Ferulok"®, the flareless type with the visible "bite", especially for heavy-wall tubing... in steel and stainless steel.

"Weld-lok" socket-type fittings, steel or stainless steel. Also "Braze-lok", in almost any metal.



"Intru-lok", especially for instrumentation lines. Flareless type in brass and aluminum.

Parker "no-skive" hose and "Hoze-lok" re-usable hose fittings for low, medium and high pressure service

Only from Parker

such a wide range of fittings...so fast

If it's an industrial fitting, whether for tubing or for hose, Parker has it or can make it, in standard sizes in any metal.

Parker "Triple-lok" for flared tubing . . . Parker "Ferulok"® for heavy-wall tubing . . . Parker "Weld-lok" for high-temperature, high pressure lines. ("Braze-lok", our newest line, does not require an open torch, is for medium temperatures.) "Intru-lok", for copper, aluminum or plastic instrumentation lines, requires no flaring. Parker hose and "Hoze-lok" re-usable hose fittings require no skiving of the hose.

There's a Parker distributor near you, write us for his name . . . call him for Parker catalogs.

Parker Fittings and Hose Division
17325 Euclid Avenue • Cleveland 12, Ohio

A DIVISION OF PARKER-HANNIFIN CORPORATION

DEVELOPMENTS TO WATCH...

Give high-purity metals a chance to relax . . .

. . . and their fatigue life may be increased considerably, NASA-sponsored research suggests.

Tests at California Institute of Technology indicate fatigue life of high-purity aluminum can be increased 30 to 60% by providing for rest periods at elevated temperature between loadings at room temperature. But the reverse is not true: room-temperature rest periods between elevated temperature loadings do not increase fatigue life, and resting at or even below the recrystallization temperature may actually have a detrimental effect on alloyed metals.

Advantages of relaxation were found with specimens containing 99.993% Al (recrystallization temperature, 400 F). They were tested at room temperature after 30-minute rest periods at 150 F, 300 F, and 450 F. Greatest increase in fatigue life (57%) was obtained at 300 F. Resting at 150 F gave an average increase of 39%; at 450 F, 25%.

A fungicide for plastics . . .

. . . that also shows promise for paints, natural fibers, rubber and leather, has been developed by Ottawa Chemical Co, Toledo, Ohio.

Specifically formulated for use in semirigid and flexible polyvinyl chloride compounds, it's said to "prevent the development of any significant growth of various fungi, and to prevent the loss of plasticizers," and therefore to prolong the life expectancy of PVC coatings and films. Other advantages: It is less toxic than most compounds of its type, and does not "bloom" or cause discoloration.

The compound (a derivative of parachlorometaxylenol) should be available commercially this month for PVC applications—with formulations for other materials to be made available when current tests are completed.

Battery-operated radar sets are on the way . . .

. . . David Linden of the Signal R & D Lab told a recent NEMA battery section meeting that transistorization of circuits and improvements in dry batteries themselves will do the trick. Already under development is a 150-watt radar set. That's still too big for today's batteries but, he indicated, a 60-to-70 watt unit is definitely in sight.

Batteries that will give "many more times" the present power output per unit weight and volume are still needed, though. Micro-modular construction is making it possible to incorporate as many as a million parts in a cubic foot, and that means a lot more power will be needed.

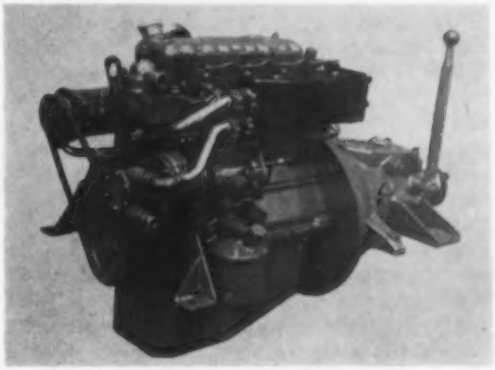
Chemical systems are still the best hope for supplying such needs, Linden believes. Solar energy has limited application owing to the comparatively brief periods in which sunlight is available and nuclear energy presents safety problems.

Baby diesel engine that develops 33 shp at 3000 rpm . . .

. . . and has an intermittent operation rating as high as 40 shp at 3600 rpm, weighs less than 500 lb. It's a 4-cyl in-line engine that features a new-type combustion chamber. Cylinder bore is 3 in.; stroke, 3.5 in.; swept volume, 99 cu in. Nominal compression ratio is 20:1.

The upper part of the combustion chamber, machined into the cylinder head, is hemispherical. The lower part is formed by an inserted machined plug which contains the throat or oval port connecting chamber to cylinder. A pintle-type nozzle is used for fuel injection.

F Perkins Ltd, Peterscourt, Peterborough, England (Canadian office: 60 Wingold Ave, Toronto 19), says it's now in production as an inboard marine engine, is under test in harvesters and combines, trucks, taxis, and other mobile equipment.



New British diesel can be fitted with direct or 2:1 reduction drive, standard or oil-operated gearbox. It has a rotary fuel pump and an eccentric-lobe-type oil pump.

DEVELOPMENTS TO WATCH...

Atoms aid conveyor studies . . .

. . . in West Germany. News reports from Bonn say mining engineers have been using radioactive tracers to determine the speeds attained by different sizes of coal passing through vertical pneumatic-conveyor pipes and horizontal hydraulic conveyors. But the technique could readily be applied to many other types of materials and other types of conveyors.

The method is a simple and straightforward one: radioactive material (in this case, bromine-32 compounds are used) is added to the coal in small amounts but enough to be detectable through the walls of the conveyor. Then, radiation detectors are installed at various points along the pipe. As the radioactive material passes the detector, it sounds off, and the difference in time between arrival at the detection points indicates the speed of travel.

(Note: for information on belt conveyors and their application to machine design, see upcoming issue.)

Counting circuits that measure in "light-feet". . .

. . . the time it takes light to travel a distance of just one foot—have been developed by Computer Equipment Corp, Los Angeles. The company intends using these millimicrosecond "space-time quantizers" in a supersonic sled velocity-measuring system it is developing for the Air Force, but thinks their accuracy—one part in 278,000,000—should pave the way for other counting and computing systems combining extremely high accuracy with simplicity, flexibility and automaticity.

One-side heating may pose far more severe design problems . . .

. . . than the mere fact of elevated temperature alone. Recent studies of laminated plastics, for instance, indicate that the stresses created by differential thermal expansion as laminates are heated from one side only may reduce elasticity in bending by as much as 35%.

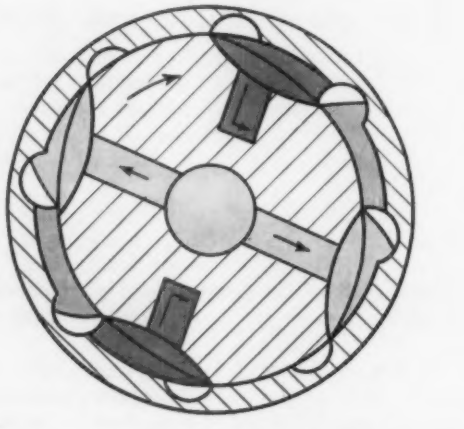
Further information is scanty on this increasingly important effect. As H. T. Plant and L. S. Lazar of General Electric pointed out to the last SPI Reinforced Plastics meeting, thermal effects on the mechanical properties of such materials as glass-reinforced plastics are normally studied under conditions of thermal equilibrium. Their own studies of one-side heating to 50 F under load at various rates show marked differences from conventional stress-strain curves. Their recommendation: Much more attention should be directed to this effect, particularly since it may prove useful as well as troublesome. "Structures might be designed," they point out, "so that the thermal bending moment opposes the moment developed by the applied load." That way, the effect could be a positive design factor.

Rotary pump that aims to overcome two major causes of cavitation...

. . . has been designed by J. T. Nash, Conflow Corp, and is now undergoing final tests.

In effect, says Nash, the new pump is an inversion of the sliding-vane type, with the cam shape in the rotor instead of in the housing; while the vanes are located in the housing and do not revolve with the rotor. This gets around the problem of inlet restriction (fluid enters through center of shaft instead of impinging directly on vanes), and also minimizes the cavitation problems associated with rapidly expanding pump chambers. Furthermore, the pump is said to operate quietly and smoothly at speeds to 12,000 rpm, and to be free from output pulsation and adverse frictional drag.

For background information on this and other positive-displacement pumps, and on cavitation, see *PE—Mar 2, p 47.* —ARG



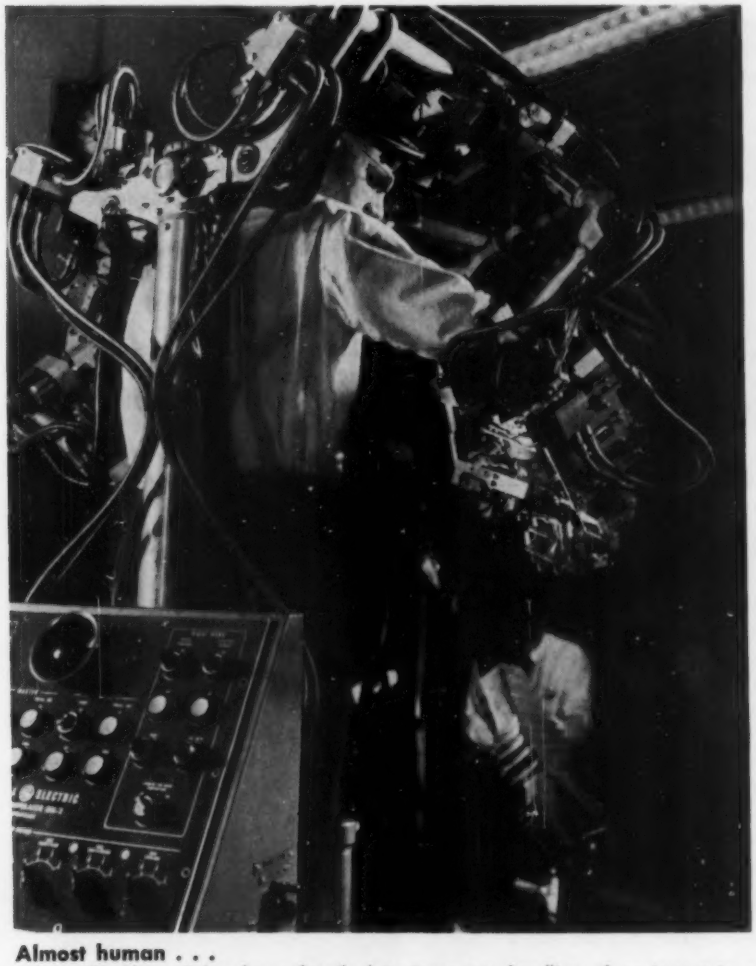
In new pump design, centrifugal forces build up pressure from center outward in suction area.

The Handyman—Slave Arms Getting Closer to Human Motions

SCHENECTADY—The latest design ingenuity for the remote handling of radioactive materials is an electro-hydraulic servo-manipulator with a bi-lateral (force-reaction) feature and articulating fingers. Called the Handyman, this robot equipment was developed by General Electric's General Engineering Laboratory for the company's Aircraft Nuclear Propulsion Dept at the Idaho Test Station.

Design of the manipulator is unique in that there is no direct mechanical connection between master and slave. Each unit has its own packaged hydraulic system. The two are connected by cable to permit random location of the slave with respect to the master. At present, the Handyman is being used in the "hot shop." The master unit is outside this area on the safe side of a 4x2 ft-area, 6-ft thick window. The slave unit inside is carried to each job, another GE remote-control manipulator.

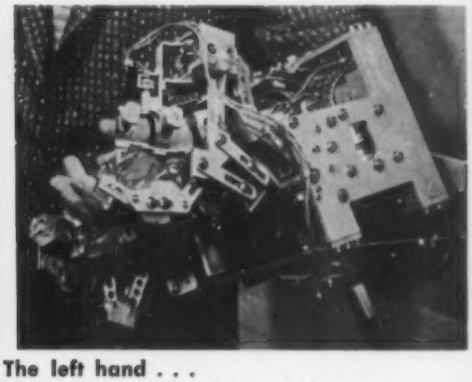
The Handyman master unit has control over 20 independent motions —10 in each arm and hand. The Handyman hand has five motions: thumb pivot, thumb curl, finger pivot, finger curl, and wrist pivot. In the extended positions, each slave arm can lift a weight of 75 lb. With the arms not fully extended, a greater weight is possible. When fully extended, one from the other, the slave arms have a reaching capacity of 9 ft. Because of its strength and versatility of hand motions, similar to the human arm and hand, the Handyman does not require a wide range of special tools and facilities.



Almost human . . .
is how "Handyman" has been described in its remote handling of equipment in a radioactive area. Rubber glove-coated slave hands can be seen in the background, lower right. The master unit, above, is mounted on a wheeled platform which the operator can raise or lower by pedal control. Console, left, for changing force-reaction settings, is controlled by an assistant.

HYDRAULICS BETTER

Ralph Mosher, Handyman project engineer at GE, says that a hydraulic system was chosen because it gives highest force for its weight and size; it eliminates the unilateral gear train required with a system using electric motors small enough to be a practical package. A special servo counterweight system was designed-in to make all parts of the master and slave units feel weightless to the operator. This feature is an improvement over the Handyman announced two years ago having cumbersome counterweights attached to various parts of both units. Another redesign of the hydraulic system was made possible with development of a hydraulic servovalve and actuator that was installed next to the linkage it had to power. This valve eliminated one



The left hand . . .
of the master unit reveals its complexity. Completely counterbalanced hydraulically, the entire unit is weightless to the operator. There are two separate hydraulic systems. The master unit operates at 1100 psi, and the slave unit operates at 1500 psi.

spool by using an A/2 piston, putting supply pressure on the half-area side, and controlling pressure with the full-area side. With this design, it was possible to eliminate a push-pull control. It was also possible to increase the stability of the servovalve, decrease the threshold, decrease the friction on the piston and the leakage potential because one seal is required instead of the usual two.

These compact servovalve actuators eliminated the control line compression and expansion problems previously encountered. Elimination of hydraulic control supply lines reduced the number of hydraulic lines from 20 to two. Without the flexible hydraulic lines, the servo loop gain could be raised enough to reduce the compliance from 20% to 4% and increase the speed of response five times.

The manipulator crossover frequency ranges between 3-10 radians per sec, and the slave unit will follow a signal of that frequency with only a 90° phase lag. Perhaps a better example of the manipulator's dexterity is that it can hold a baseball bat and swing at a pitched ball. In one game it got six base hits out of seven pitches.

Already at the Idaho Falls Test Station, Handyman has been doing jobs in several minutes that required about 1 hr with previous manipulators. GE figures that with its human-like abilities the Handyman will easily pay for itself.

KINESTHESIA

Part of the forces encountered by the slave unit are reflected back to the master control so that the operator experiences muscular sensations as if he were doing the job directly. Reducing the master unit's force levels compared to the slave's is simply a matter of diverting a corresponding portion of the current going to the master servovalve torque motor. The operator can adjust this reflected force in increments of 3 to 1; 5 to 1; 10 to 1; and zero. Thus, for example, 3 lb of force experienced by the slave unit reflects 1 lb back to the operator at the master unit.

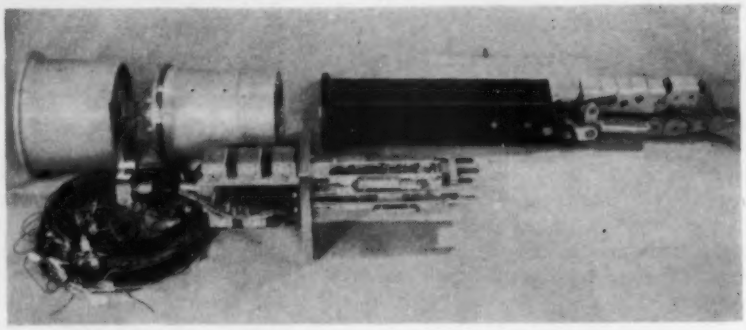
The 10:1 ratio is used to pick up heavy loads, but the 3:1 ratio is used most, according to Mosher, because greater reaction sensitivity will result in better performance. The zero force reaction setting is used if the object must be held a long time. With no load feedback, the operator does not tire. For further variety, six sections of the system—three in each arm—can be put into different reaction levels.

About one hundred gears, ranging from $\frac{3}{8}$ in. to 2 in. in dia, are in the manipulator, but a special gear-train design, on which Mosher has a patent, keeps package size at a minimum.

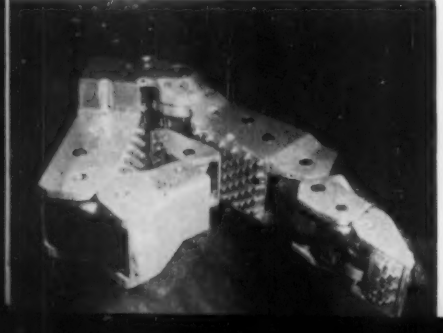
Single and multiple stages of sun-planet-swing link gear combinations permit finger and thumb articulation. Also, they permit assembly of parallel gear trains on common axes, with undesirable interaction of forces and motions excluded.

It is possible to get articulation other ways—with steel tape or a bell-crank linkage—but Mosher feels these methods don't give the high force in a small package. He says that high-carbon, precision gears are used, and that backlash is no problem. Root stresses in the teeth reach 80,000 psi and compressive stresses hit 280,000 psi. Bearing loads are up to 800 lb on a $\frac{7}{8}$-in. shaft. Needle bearings without the usual trunnions increase the contact length.

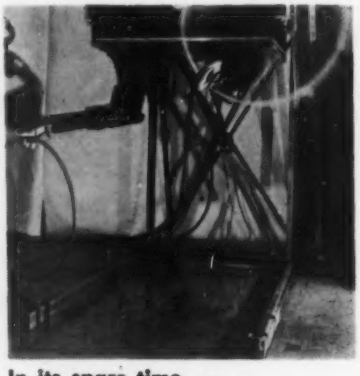
The Handyman slave manipulator can be used at distances up to 1000 ft from the master unit with the cables handled on a reel or supported by a pylon. At this distance, the self-propelled slave unit would require a built-in television transmitter. For this and greater distances, a radio-controlled slave unit is considered feasible, but would require extensive redesign. Mosher says the performance potential of manipulators have been increased because of the bilateral hydraulic servo system; a servo counterweighting system; a multi-freedom mechanical hand; and master arm kinematics that easily conform to the biomechanics of the operator's arm; and compact packaging.



An exploded view . . . of arm shows a nest of 5 servovalves (left, foreground) with the rams connected to the racks (center, foreground). Complete unit fits into the slave-arm casing directly behind it and connects through a gear train to the hand and fingers at far right. Servovalve and piston package is 4 in. dia and 6 in. long. Between the nest of 5 servovalves and the racks is a mechanical, fail-safe system to make hand immobile.



Open wide . . . a close-up of the slave hand shows the joints in the open thumb and the curled finger. Small buttons on the "palm of the hand," thumb, and fingertip are spring-loaded to improve the grip.



In its spare time . . . the slave enjoys itself by spinning a hula hoop on one arm while the other hand holds a second hoop.

Martin's 5-lb A-Generator Wins Miniaturization Award for '58

NEW YORK—A 5-lb atomic generator that for the first time extensively combines a radioisotopic heat source with a highly efficient thermoelectric conversion has been awarded the Miniaturization Award. It was developed under AEC auspices by the Nuclear Div of Martin Co, Baltimore, in conjunction with Minnesota Mining & Mfg Co. The device (above) is 4¾ in. dia.

SNAP III is designed specifically to provide auxiliary electric power for space missile systems. It derives its energy from polonium 210, and can convert the radiation emitted by ½ of a gram of radioactive material into 5 watts of electricity at an efficiency of 8 to 10%.

In addition to its light weight, and long operating capability suiting it to space applications, it promises applications wherever small sources of electricity are needed. For example: replacing batteries in air and sea-navigation aids or on communications lines, providing power for longer periods and minimizing the cost of maintenance.

CAPSULE NOT DANGEROUS

Commenting on the danger posed by the presence of polonium in SNAP III, AEC Chairman John A. McCone said recently: "The small particle of polonium was encased first in a welded stainless steel capsule. This capsule was secured inside a second capsule which in turn, was encased in a third capsule. It is difficult to imagine how the polonium could come into contact with anyone."

Some 10 other firms and individuals were awarded certificates-of-excellence:

V. K. Zworykin, RCA, for developing a capsule-sized radio pill for medical diagnosis; Elgin Micronics, Div of Elgin National Watch Co, for a microminiature synchronous motor and gear train for an elapsed-time indicator; Robert W. Yancey, Diamond Ordnance Fuze Labs for work on a subminiature telemeter; Peter J. Pijoan and John Buckley, Westinghouse Air Arm Div, for contribution to development of a miniature high-speed gyro motor; Sonotone Corp, for its Model "222" hearing aid, the first worn entirely in the ear; Patek Phillippe & Co, Geneva, Switzerland, for a miniature frequency and time standard; Keith O. Johnson, Stanford Univ student, for a 4-channel magnetic tape recorder about the size of a kitchen matchbox; Heald Machine Co, for a grinding machine for improved production of miniature ballbearing races; Servomechanisms Inc, for an evaporated magnetic film stepping strip which reduces the size of a memory element in high-speed digital computers; Diamond Ordnance Fuze Labs, for pinhead-size indicator lamps.

Miniature power plant . . . Engineer at Martin's Nuclear Div tests radioisotopic "battery" which won 1958 Miniaturization Award. The 5-lb atomic generator can produce 5 watts of power at an efficiency of 8 to 10% from ⅓ gram of radioactive material.

Booth Says Europe Not Impressed by Advent of US "Small" Car

DETROIT—The current trend in American styling will have little effect on forthcoming European cars. This is the opinion of Arthur G. Booth, world-renowned automotive engineer and ex-chairman of England's Institution of Mechanical Engineers', Automobile Div., who told PRODUCT ENGINEERING: "You are now going in a direction we in the foreign car field have followed—less lavishness in decorative trim, particularly in your extraordinary front and rear ends."

Interviewed during the recent SAE National Automobile week here, the peppery elder statesman of international motordom opined that America's "300-hp ballistic missiles are the main danger on the road today. They can hardly pass without shaving off paint, whereas our product has all the room in the world. With your average loading of 1.6 people, why should you have all that horsepower except to lug 4000 lb of steel and other materials?"

"Our cars," he said, "are continuing to sell in America because people are getting to like them. But no one in Europe is designing our volume units just for the American market. We have our own market which is large enough."

He did not consider America's forthcoming "small cars" really small, noting that their presumed specifications, dimensionally and horsepower-wise, closely approximate American low-priced cars of the mid 1930s. He flatly stated that no program is on foot to blow-up European volume small cars to the size cannoted by the American definition of small car. Nor, did he expect a significant power increase in European imports. "We are always looking for more power," Booth said, "but we will not sacrifice economy, weight, or cost. Generally, continued advances will come from further development of the already highlyrefined 'square' engines that the British have had for the past five years.

"The well-publicized transition of your 'big three' to the smaller car will not be economic for them, because initial outputs will be small enough to make costs comparable to volume units. This will be true for some time, until the transition is complete —and I doubt if they will ever follow this route to a conclusion.

"These new cars may reduce quality, but this will have to be with the refinements that go with the car. You can't cut quality of the body, regardless of size, nor engine or transmission. The public will demand these.

"You are on the wrong track with your cars," he said. "They are too powerful and uneconomic, and covered with details that are not functional. And," he added, "I hope that they will continue that way."

Germans Emphasize Special Designs For Ultrasonic Flaw Detection

BONN—In post-war Germany, designers of ultrasonic equipment have concentrated on special units to do specific jobs rather than general purpose gear. And with suitable transducer design and choice of crystals, engineers can build equipment for just about any ultrasonic test problem.

This philosophy of German ultrasonics design was described by Josef K Krautkraemer, one of this country's leaders in the field and the director of research for J & H Krautkraemer of Cologne.

Dr. Krautkraemer further asserts that conventional German equipment is well in advance of its US counterparts. He attributes Germany's lead to her designers' emphasis on reducing weight and size of units and to their fashioning special probes for the job at hand. By way of illustration, he adds that the smallest flaw detector made by a typical US manufacturer in the US weighs 45 lb; a comparable German unit weighs 12 lb.

[Branson Instruments, Inc., Stamford, Conn, has just announced an ultrasonic thickness measuring device weighing less than five lb. The self-contained instrument includes batteries, probe harness, cable and earphones, and is useable with most metals, glass, ceramics and plastics that have a thickness from 0.09 to 5.0 in.—Ed.]

Echo ranging is most frequently employed for non-destructive testing and inspection of materials here, using short sound pulses from 0.1 to 2 microseconds with ultrasonic frequency of 0.25 to 10 megacycles.

Most German units incorporate fast time base speeds and high trace brightness. Most are combined with a rectified or unrectified trace display to permit comprehensive analysis of the echo's shape. With recent advances in capacity and versatility, ultrasonic equipment is challenging conventional test equipment in the metalworking industries and elsewhere.

Sounding for flaws . . .
This ultrasonic equipment is testing welds on the Wilhelmshaven-Cologne pipeline. In foreground is tester mounted on swiveling tripod and strapped to pipeline. Wheeled unit at rear runs along top of pipe with power generation equipment to supply current for flaw detector.

Lightweight flaw detector . . .
can be carried easily by operator. Indicator shown at side of probe locates the position and depth of defects.

MEDICAL USE

In the medical field, for example, Krautkraemer's devices are going to Swedish medical institutes for diagnostic applications. Dr. Arvo Oksala of Finland's National Opthalmic Institute is using a specially-designed 10-mm dia probe to diagnose ruptures of the sclera and detachment of the eye's retina where normal diagnostic methods fail. To eliminate disturbing influences, the blepharostat that opens the eye for observation is connected by fine copper wire to the crystal vibrator of the probe. Sound between eye and probe is transmitted either through paraphin or a 1% solution of methylcellulose pipetted to the eye surface.

A twin-channel unit is experimentally diagnosing brain tumors and locating ruptures in cranium or brain tissue at the Stockholm headquarters of Prof. Leksell. The separate channels allow individual probes to be positioned at each side of the patient's head. The resulting trace display enables the diagnostician to determine the extent and location of tumor damage accurately.

Additionally, experimental work under way in several German, Swedish and Finnish hospitals is ultrasonically determining expansion and contraction of heart walls as blood is pumped.

In reactors, fuel element failure can be traced to a poor bond between fuel element and the cladding can, or to fractures and discontinuities in can material. A probe now in test phase has two lead-zirconite crystal transducers in a cone shaped holder. The crystals are positioned at a slight angle to one another and are electrically and ultrasonically shielded by rubber and hard paper. Originally, fuel elements and cans under test were immersed in water and rotated while the probe was held 1 mm from the outer surface of the can. With the new model, clad fuel elements are mounted in a device similar to a lathe faceplate and rotated slowly while the probe in a water-filled compartment is moved along the length of the can.

Working closely with the Swiss Federal Railways, Krautkraemer has developed a fully automatic unit to test rail lengths at 32 in. per sec.

When the rail enters the test machine, a high speed wire rotating brush cleans the top surface of the rail. As the rail progresses, it automatically switches on the first probe which is aimed vertically into the rail. Any flaws or cracks actuate a monitor that produces an audible sound and has a paint dauber apply red paint along the lower flange of the rail for the length of the flaw.

As the rail continues, two additional

probes automatically scan the rail at 70 deg angles from horizontal. Discontinuities will again reflect a portion of the beam to a second monitor with audible warning and paint dauber. This dauber trails a blue line along areas of the flaw. Minute discontinuities will throw back only low amplitude echos that are too weak to actuate painters.

Krautkraemer recently installed a unit to test plate material discharging from the finish end of a rolling train. This plate varied in thickness from ¼ to 2-in. To scan this moving plate, water was used as a transmitting agent. To keep the water from vaporizing, a twin-line of nozzles above and below the mill-train table was staggered so that space between nozzles was one inch. Above the nozzles on top of the plate, was a series of ultrasonic transmitters connected to a common quartz crystal transducer. Each transmitter was positioned directly above its nozzle so the beam could be passed through the water to the plate.

Receivers below the nozzles on the underside of the plate were connected over individual amplifiers to an ink recorder. An unbroken ink line is recorded as long as the sheet is sound. Laminations, inclusions, or segregations in the metal sheet will interrupt the charted line. Speed of plate through the test unit varies between 16 and 32 in sec.

Optional "B" scan presentation is available with the latest German flaw detectors. In the newest Krautkraemer unit, scan presentation is obtained by contact so that a direct photograph can be taken by a camera located in front of the cathode ray screen. In US practice, "B" scan is generally obtained through an immersion technique.

For flaw detection in thin gauge steel sheet—0.023 to 0.078 in thick—Krautkraemer employs an ultrasonic probe directed into a reflector positioned at an angle below the surface of the sheet. High intensity oscillations pass along the plate before being deflected by a second reflector into a receiver amplifier also positioned on the underside of the sheet of metal. The transmitter and receiver back and forth across the underside of the sheet, scanning three ft of metal each second.

Though it is now only in research stage, Krautkraemer has high hopes for an automatic flaw detector for thick welds. This probe has a stationary crystal to determine whether the probe is making good contact with metal surface. A second transducer unit swivels vertically five to ten times a sec through an arc to scan the entire metal weld.

COMING EVENTS

APRIL

5-10 . . . Engineers Joint Council (coordinator), 1959 Nuclear Congress, Public Auditorium, Cleveland, Ohio.

13-15 . . . American Society of Mechanical Engineers, Hydraulic Conference, Univ of Michigan, Ann Arbor.

13-17 . . . American Foundryman's Society, 63rd Casting Congress and Engineered Castings Show, Sherman Hotel, Chicago.

20-22 . . . Metal Powder Industries Association, 15th Annual Meeting and 1959 Powder Metallurgy Show, Sheraton-Cadillac, Detroit.

29-May 1 . . . American Society of Mechanical Engineers, 1st National Metals Engineering Conference, Hotel Sheraton-Ten Eyck, Albany, N. Y.

MAY

20-22 . . . Society for Experimental Stress Analysis, 1959 Spring Meeting and Exhibition, Sheraton Park Hotel, Washington.

25-28 . . . American Society of Mechanical Engineers, Design Engineering Conference, Convention Hall, Philadelphia.

25-28 . . . Design Engineering Show, Convention Hall, Philadelphia.

Test Island . . .

Replacing gas turbine compressors and electrical starter carts, this Chance Vought engine run-up ramp features fixed compressed air "islands" to speed pre-flight test operations. (At left is aerial view showing 23 aircraft positions which the ramp services). Three 40-ft tanks (left, background) store compressed air at 100 psi in interconnected receivers to supply each island. Air from the receivers is carried through filters to the islands where it is reduced to 35 psi. A geared probe is plugged into the side of the aircraft near the front of the jet engine. An air turbine starter can in 18 sec. turn up at 32,000 rpm and is geared down to 2400 rpm at the probe. When engine rotors reach 35% operating rpm, an automatic cutoff disengages probe. In addition to air hose and mechanism to supply clean air, (right) electrical connections supply 28-v direct current to actuate the planes' various electrical systems. Each island provides six quick-disconnects for air hoses while four of the islands are equipped to check cockpit air pressurization.

One Out of 5 Favors Collective Bargaining

ANN ARBOR—Collective action to improve their salary and social status is favored by one out of five scientists and engineers in large business firms, according to a University of Michigan survey.

Some 10% of those interviewed think of collective bargaining in terms of union activity. The remaining 8% think their professional societies could do more collecting and distribution of salary and related information to their members and management.

Contrastingly, 50% were strongly opposed to any form of collective bargaining for scientists and engineers, and 29% were mildly opposed to the idea. About 3% had no opinion.

Other highlights: (1) There are no significant differences between scientists and engineers in attitudes toward collective bargaining. (2) There is no significant relationship between ratings of an individual's performance and his attitude toward collective bargaining. (3) There is quite a high relationship between how an individual feels about his salary and how he views collective bargaining. (4)

System Speeds RR Car Identification

CHICAGO—A "response block" containing only a transistor, two ferrite rods, diodes and filters and encased in epoxy resin to last indefinitely, was shown at the Railway Systems and Procedures meeting here as one of two features of a new car identification system developed by Link Aviation.

Measuring about 4 x 4 x 1 in., the block is attached to the underside of a freight car or bus, and gives an identifying signal when excited by a magnetic coil placed under or at the road level. An interrogator, the second element, relays the signal to a control center for integration into data processing equipment, teletype, or storage in a memory unit.

Called Tracer, the system would be capable of identifying cars passing at speeds up to 100 mph. Several million different response blocks, each with a different signal, can be manufactured.

Link feels that the system could be used to control movement of airplanes on the ground, plant security patrols, and movement of industrial products.

Reader To Editor...

Tesla's Impressive Demonstration

To the Editor:

I note that a reader, Mr. Maxwell Graham (Feb 16, p 26), has injected another name, that of Nikola Tesla, into the Westinghouse-Edison discussion. Edison, who was on the defensive and grasping for straws, made the assertion that alternating current was too dangerous for public use. Tesla made a demonstration before an invited group of viewers and used his body as part of a circuit carrying alternating current at high frequency.

I desire to inject three more names into the discussion, those of Stanley, Kelly and Chesney, the projectors of the S.K.C. system of Stanley Electric Co. Their ac generator had no slip rings or brushes. All wiring, both dc and ac, was stationary. I have seen only one generator—it was operating at Lock Haven, Penna about 60 years ago.

The important point is they were assured a US patent on an induction motor based on one theory while the Tesla patent was based on another theory, entirely different. Both patents were valid.

General Electric Co had acquired the Edison and Thompson-Houston properties but was not in position to make and market an induction motor. After a few years of negotiation GE finally succeeded in purchasing Stanley Electric Co.

—EDWIN R NORRIS
North East, Penna

ENG. Smith

To the Editor:

Regarding the article, "Publicize the Engineer?—Yes, but How?" (Dec 8, '58 p 39) may I suggest that every bona fide engineer use the prefix or suffix "ENG." before his or her name instead of Mr. or Miss. Let this suggestion prevail at all times, whether addressing the engineer orally, or with any other means or communications.

Dentist's, MD's, and other professions adopt their distinguishing symbol or titles before their name, so why not the "Engineer?" —CARMIN A GUERRERA
Grosse Pointe, Mich

10 Commandments to Motoring Progress

To the Editor:

To G. E. Lips, Julianadorp, Curacao, Netherlands Antilles, an orchid for his list of 10 suggestions to free motorists from the clutches of hysterical stylists (Mar. 2, p 26).

What a boon it would be to car owners if these suggestions were put into effect by auto manufacturers! What a setback to inflation! This list looks to me like the 10 commandments to common-sense motoring progress.

—EARL L KEELER
Indianapolis, Ind

All-out Entrepreneur

To the Editor:

I enjoyed your article "One Man Engineering Firm" (Feb 23, p 30). As one of the ". . . race of men that don't fit in," I feel you have described our problems, our thoughts, and our ambitions as one who has experienced them himself. As an ". . . all-out entrepreneur," it is comforting to know that there are others who feel as I do.

—ROBERT H KLINE
Akron, Ohio

Liquid-level Controls

To the Editor:

In the "Why Don't They R & D" section of the Jan 12th issue (p 52) Mr. J. M. Fitzpatrick has commented upon the need for a particular type of liquid-level control. Such controls have been available for many years and are generally known as floatless, electrode type, liquid-level controls. We, ourselves, manufacture a line.

—WOODWARD H WARRICK
Charles F Warrick Co
Berkley, Mich

Plea for Better Drafting Equipment

To the Editor:

Concerning drafting boards and the article on the Dutch version of antiquated American methods and positions, (Mar 9, p 6) I can certainly agree it's progressive.

I've been in perhaps a hundred offices since 1926 and I've seen boards and carpenter horses over lags of green paper rippled like canyons and valleys. I've been given a space practically on top of a boring machine. I've seen my board pinned against the wall for lack of space; a pencil dropped required a contortionist act to recover. I've seen my fill of 6′ drawings on 3′ boards. I've seen estimators guess at job requirement time when it took that long to find $\frac{1}{8}$ of the prints to do the job. I've seen six bosses and one draftsman—six $10,000-a-year men and one $5200-a-year man doing their work.

—HAROLD WATKINS
Chicago

A Nation of Faddists

To the Editor:

Congratulations on your editorial in the Mar 2 issue entitled, "Engineering—the un-noted catalyst." You have really hit the core of the problem involving lack of professional recognition of engineers.

Unfortunately, we in America seem to have degenerated into a nation of faddists The promotional vehicles toss out a cliche or a pet word and build it up in the minds of the public until it becomes "the thing to do" or to follow. There are apparently some better salesmen among the ranks of the scientists than among engineers—or they have more lucid champions.

—RUSS HENKE
Elm Grove, Wis

CIRCLE 112 READER SERVICE CARD→

Alcoa puts the metal where you want it

This "tree" represents six stages in the growth of an Alcoa® Impact. Actually the flow of metal occurs at a blink of the eye, but we've shown it in stages, outside the die for the sake of clarity. Furthermore, the finished piece (which you see on the bottom) has no practical use. It has, however, practical value. It starts the imagination fiddling with a host of design problems that involve the joining of several spokes to a central hub. For instance, it's not hard to imagine the spoke frame for an automobile steering wheel or horn ring sitting in its place. If that idea has you going, bear in mind that we can make round, oval, square and irregular parts the same way. Finished parts in many instances have greater *strength* than forgings —with *tolerances* down to plus or minus 0.005 in.—with a smooth, corrosion-resistant finish of about 125 microinches. A clear case of putting the metal where *you* want it.

In impacts, as well as forgings, castings, extrusions and screw machine parts . . . Alcoa puts the metal where *you* want it. A call to Alcoa can mean fewer rejects or ingenious design solutions. Start now; write for Alcoa Up-To-Daters, a file of design tips on Alcoa Engineered Products. Aluminum Company of America, 928 Alcoa Building, Pittsburgh 19, Pa.

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For Exciting Drama Watch "Alcoa Theatre," Alternate Mondays, NBC-TV, and "Alcoa Presents," Every Tuesday, ABC-TV

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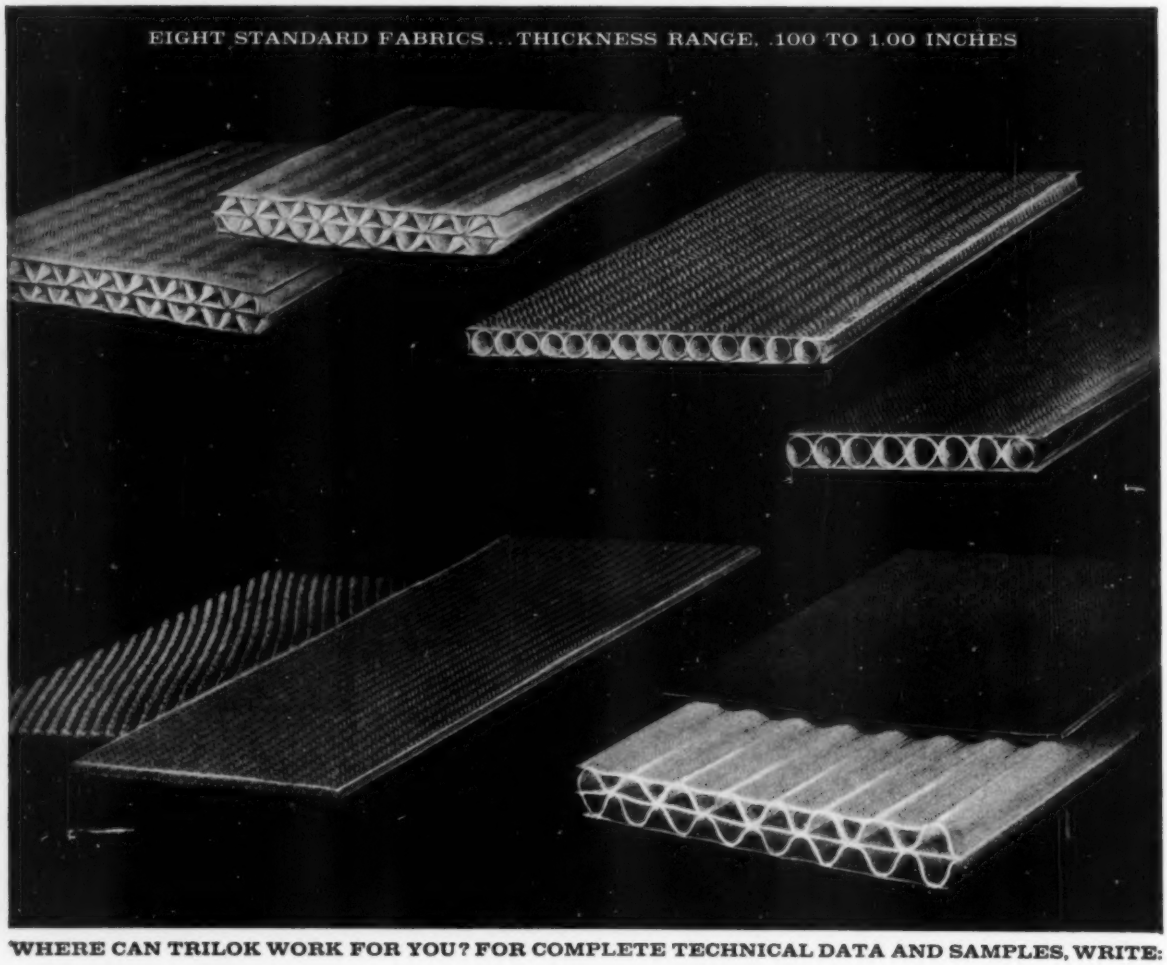
TRILOK is a remarkable 3-D stabilized weave that is solving problems and sparking ideas throughout industry. Formed by differential shrinkage of polyethylene and Saran® fibers, it is *resilient; durable; porous; corrosion, abrasion and chemical resistant; shock absorbent; and lightweight per unit of thickness.* TRILOK is performing—or can perform—in: filtering units, seating supports, protective clothing and packaging, ventilated bed-pads, self-ventilating cushions, bunk pads and vibration dampeners.



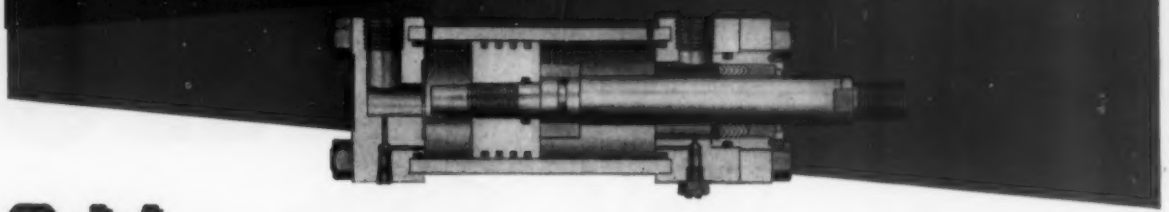
WHERE CAN TRILOK WORK FOR YOU? FOR COMPLETE TECHNICAL DATA AND SAMPLES, WRITE:

Textile Division

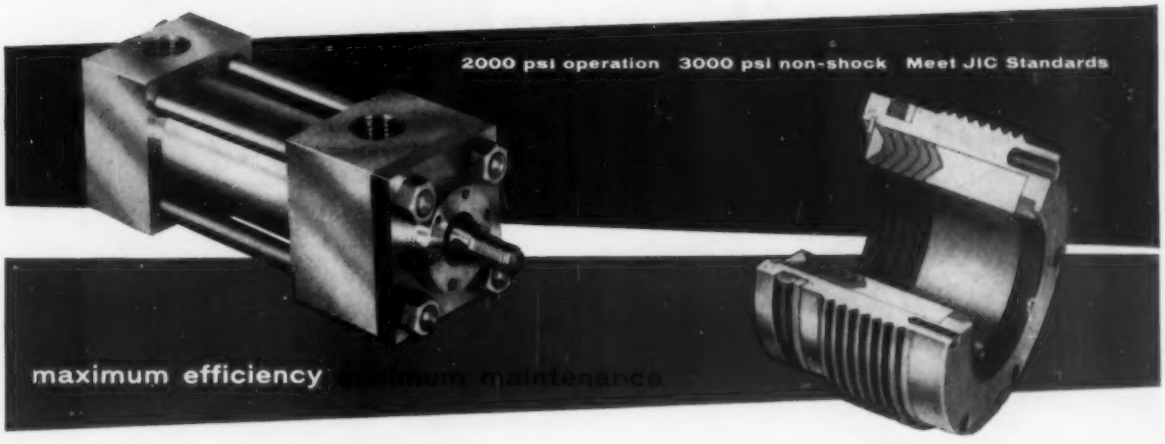
United States Rubber

Rockefeller Center, New York 20, N. Y.

sealed right!



O-M Heavy-Duty Series TH Hydraulic (Oil) Cylinders



IF you are experiencing difficulty with leakage through the seals and packings of the cylinders you have been using, the O-M "TH" Series Heavy Duty Hydraulic cylinders may be the answer to your problem. Since their introduction in 1955 these cylinders have established an enviable reputation for efficient and trouble-free service.

The O-M Series TH Cylinders are Designed Right to Seal Right. Prior to the design of these cylinders, many tests were made and field experiences were surveyed to find the most efficient way to eliminate the old "leakage problem".

Homogeneous "O" rings, with their elastic characteristics, cannot be excelled as static seals when backed-up with plasticized leather non-extrusion rings and installed in a properly designed cavity.

Ring-type piston packings are excellent for long-life and trouble-free performance when a small amount of piston by-pass is permissible. When by-pass is not allowable, "Vee-type" packings similar to those used as standard in the rod gland provide optimum sealing. The "Vee-type" packing is self adjusting and provides multiple lip sealing with excellent pressure sensitivity and long life.

The homogeneous "lip-type" rod wiper or the metallic scraper (your choice) is located well forward so as to prevent dirt from accumulating and scoring the piston rod and damaging the bearing and packing.

O-M Series TH Cylinders are "Designed Right" and "Sealed Right". Available in 1½" to 8" bores with complete selection of mountings. Mail coupon TODAY for Bulletin No. 105 showing description drawings of cylinders mountings and capacity chart.

ORTMAN-MILLER MACHINE COMPANY
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☐ Have representative call
☐ Send Bulletin 105

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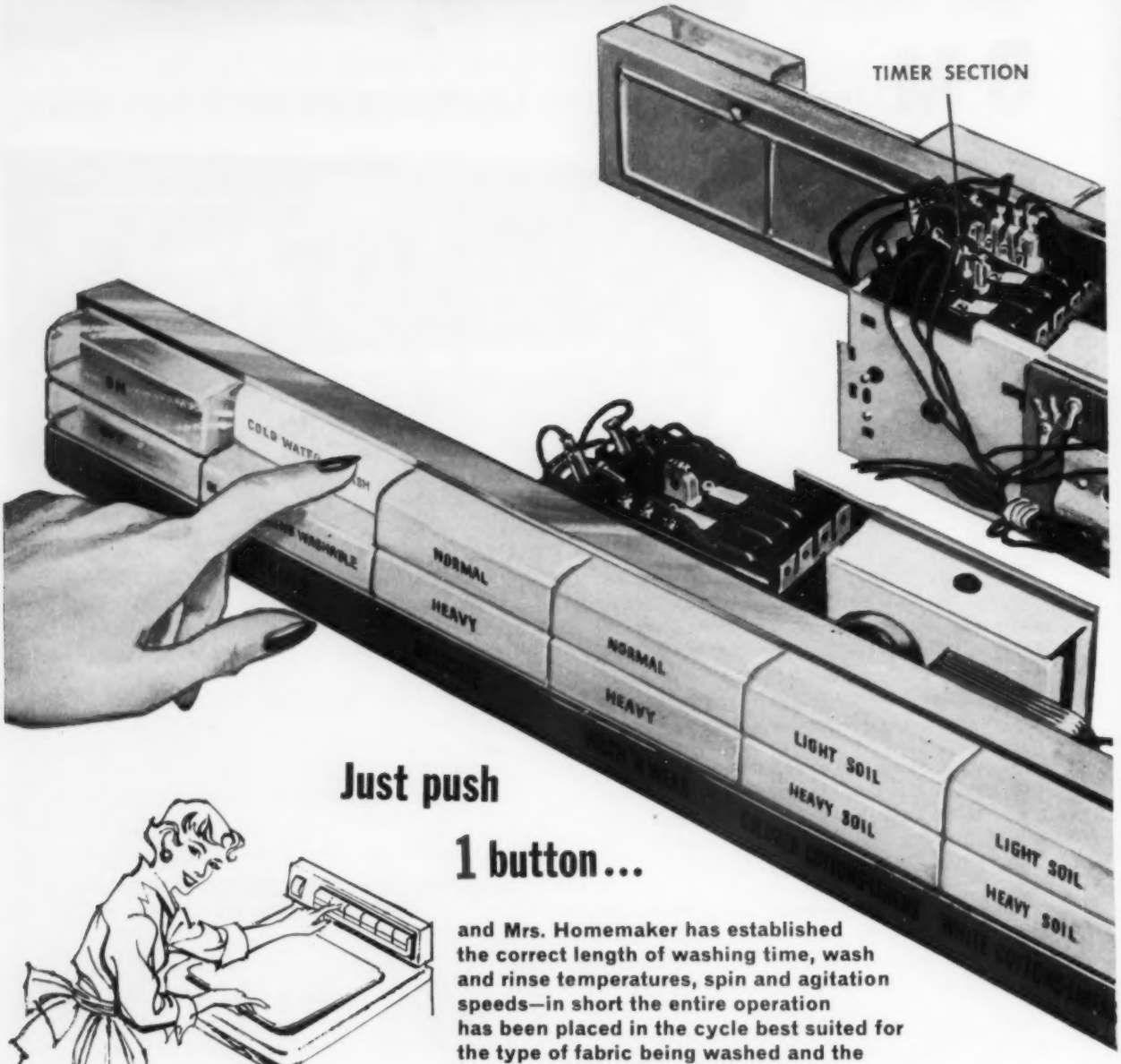
CC LAUNDRO

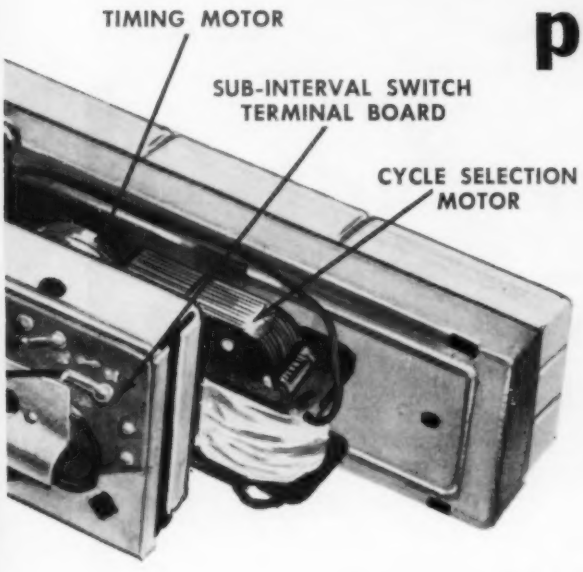


Just push 1 button...

and Mrs. Homemaker has established the correct length of washing time, wash and rinse temperatures, spin and agitation speeds—in short the entire operation has been placed in the cycle best suited for the type of fabric being washed and the degree of soiling. It is the only control available that automatically selects the right operating cycle for all these conditions. Similarly, it sets up the proper operating cycle for dryers—the correct drying time and temperature for any type fabric.

MATION

Revolutionary *NEW* cycle-set power-timer



A completely integrated control system for WASHERS-DRYERS-COMBINATIONS

Controls Company of America announces a clean break with the past with its CYCLE-SET POWER TIMER — a completely automatic control system that can be economically tailored to meet manufacturer's exact design specifications. Already this season, it can be found on the top-of-line models of leading manufacturers.

CYCLE-SET POWER TIMER is a working example of CC's new "Control Systems Approach" — a policy of furnishing manufacturers with completely integrated systems perfectly mated to the products they control. As in all CC control systems, CYCLE-SET POWER TIMER design was predicated on standard CC control components — all having long histories of successful field service. Such standardization also permits easy repair and servicing.

Only CC's broad control line and unsurpassed engineering facilities could produce a system such as this. Why not put these creative resources to work on your product? Write today for full details. No obligation of course.

Creative Controls for Industry

CONTROLS COMPANY OF AMERICA

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HUBER-WARCO

Series L6N-L6S Needle bearings or sleeve bushings. For moderate pto hp or steering jobs.

Series K With sleeve bushings. For hand controls and pto service.

These grader builders offer steering smoothness — plus ROCKWELL-STANDARD QUALITY with BLOOD BROTHERS Universal Steering Joints

Certainly, graders get their share of steering shocks and strains. And the engineers who design them expect it.

That's why grader builders so often furnish Blood Brothers Universal Steering Joints. From start to finish, they're soundly designed and ruggedly built to stand punishment.

Contractors can appreciate their steering smoothness and freedom from trouble. Design Engineers can depend on Rockwell-Standard's high level of quality—and friendly cooperation in solving special problems.

If you're not already using Blood Brothers Joints, just write or call. Our engineers will gladly work with you.

For general information, write for Bulletin 557.

ROCKWELL-STANDARD CORPORATION

Blood Brothers Universal Joints

ALLEGAN, MICHIGAN

UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

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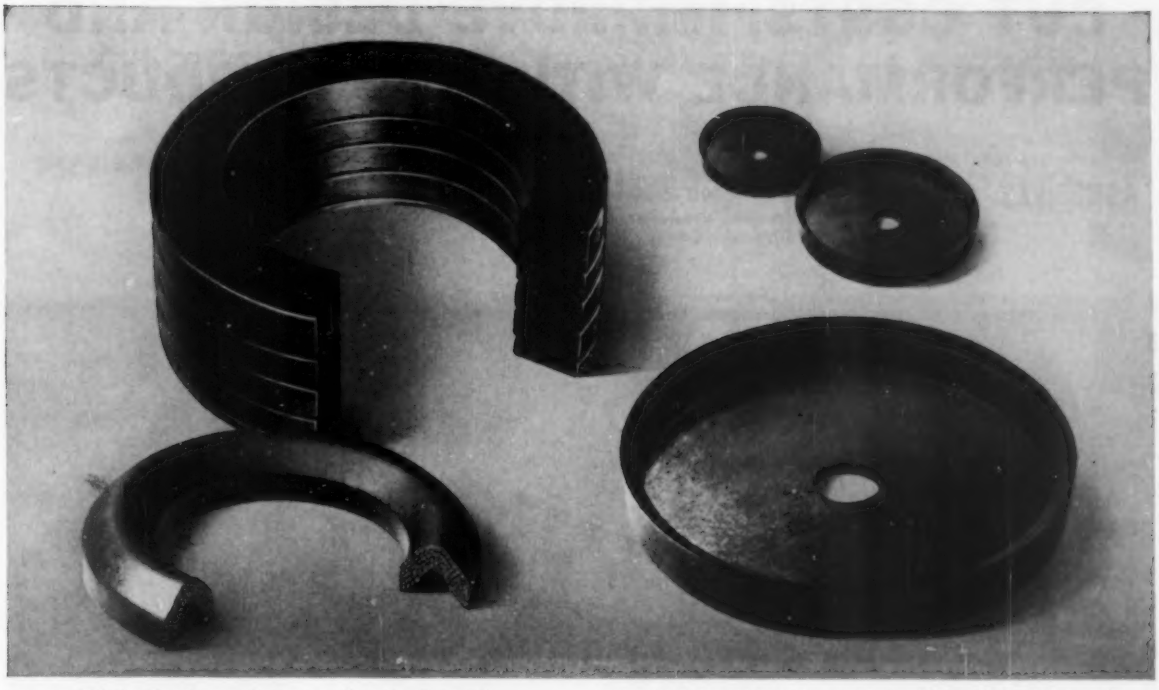

R/M Vee-Flex Rings seal automatically and will not roll.

R/M Fabric Piston Cups are precision molded and cleanly trimmed.

PRECISION QUALITY CONTROL MEANS YOU CAN RELY ON R/M V-RINGS AND PISTON CUPS

R/M Vee-Flex® Rings give better performance and cut maintenance costs for your customers. Convex curvature of the surface which touches the next ring makes them self-sealing and self-adjusting. Pressure stroke produces a seal against the stuffing box wall and the adjacent ring. Friction is reduced on the return stroke. Precision molding and trimming give you the best possible fit—and provide longer wear, because the fabric is deeply penetrated by the compound. Use them on steam or air rods, hot oil pumps, hydraulic rams, outside-packed plunger pumps, food handling machinery, accumulator and elevator rams on oil or water service.

R/M Fabric Piston Cups provide minimum friction, long life and accurate fit. Molded from a variety of rubber synthetics with fabric reinforcements to suit your specific requirements. You can see the big difference in their clearly defined contours and cleanly trimmed edges—proof of strict adherence to industry standard sizes. R/M Fabric Piston Cups fit hydraulic and pneumatic cylinders ranging in diameter from ½ to 12 in. They are produced in varying degrees of hardness for pressures up to 1500 psi and in compounds to meet your specific operating conditions. When ordering piston cups, specify R/M.

Complete information on these and many other R/M Packings is given in this free booklet. Send for it today.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS—Vee-Flex®, Vee-Square,® Universal Plastic, and "versi-pak"®; GASKET MATERIALS; "TEFLON"* PRODUCTS, including flexible wire-braided and rubber-covered hose. SEE YOUR R/M DISTRIBUTOR.

*A Du Pont trademark

R/M PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics • Sintered Metal Products • Abrasive and Diamond Wheels
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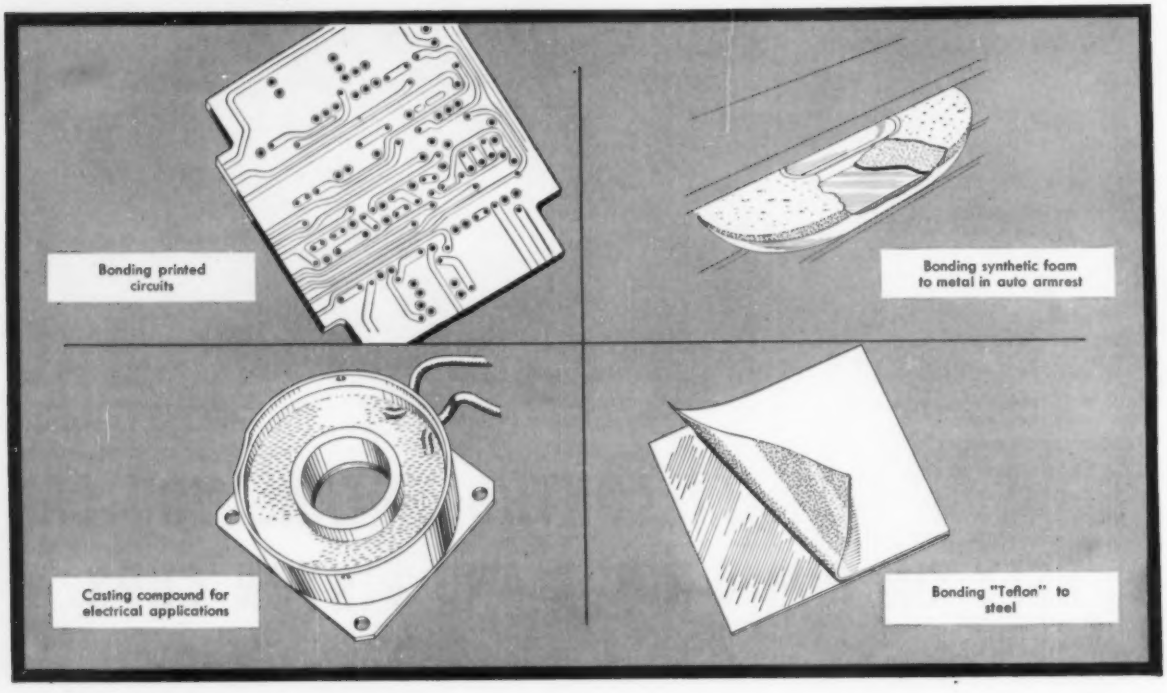
CUT COSTS, IMPROVE DESIGN AND PERFORMANCE WITH R/M PRODUCTS

ADHESIVES

Send for free copy of R/M Bulletin No. 700. Contains full information on Ray-BOND adhesives, protective coatings and sealers.

Adhesives Department, Raybestos-Manhattan, Inc.
Bridgeport, Conn.


Bonding printed circuits
Bonding synthetic foam to metal in auto armrest
Casting compound for electrical applications
Bonding "Teflon" to steel

For these and 1001 other applications —New R/M Ray-BOND Adhesives

The number of new places you can use adhesives today is growing faster than ever. With new bonding techniques and modern Ray-BOND adhesives, you can design reduced fastening time and costs into a variety of applications never before possible.

R/M Ray-BOND adhesives are of two different types—thermosetting and thermoplastic. They are available in different degrees of viscosity—for either spraying or painting. They give top performance under the most severe operating conditions —withstand temperature extremes ranging from –80° to +700°F.

Whether or not you have yet considered bonding, sealing, casting or coating in your own operations, talk to an R/M engineer about new Ray-BOND adhesives. Over 20 years' pioneering in the production of bonded assemblies and the manufacture of adhesives and coatings has given Raybestos-Manhattan a wealth of knowledge and experience that could well help you find new ways to improve your product and cut your production costs.

For special requirements R/M will tailor special adhesives . . . to meet your individual needs.

R/M

Brake Blocks, Linings and Clutch Facings

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Abrasive and Diamond Wheels

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SPECIALISTS IN ASBESTOS, RUBBER, SINTERED METAL, ENGINEERED PLASTICS

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RUBBER

Write today for free booklet shown: full details on a wide variety of industrial rubber products.
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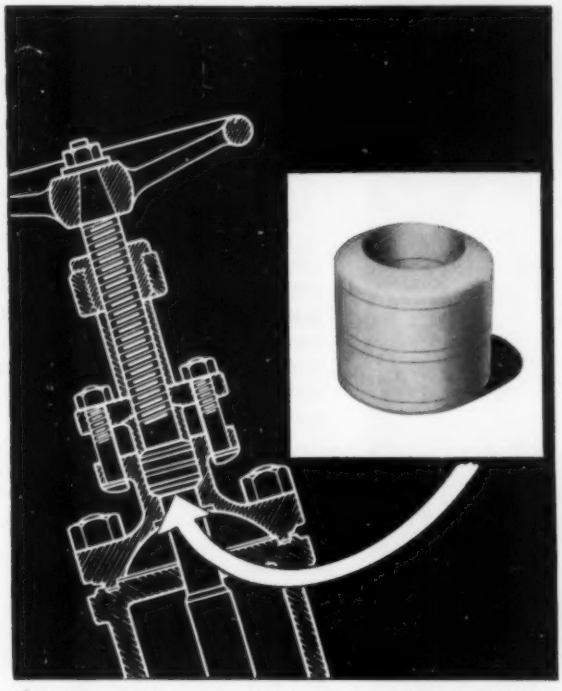


R/M Valve Stem Packings are available in many formulations for varied needs.

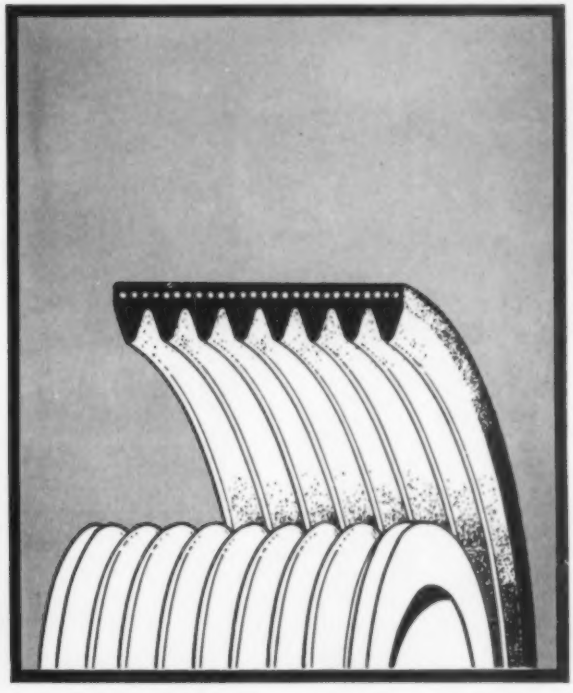
Close fit, long wear with R/M valve stem packings

You get the benefit of R/M's long experience as a leader in the packing industry when you select valve stem packings made by Raybestos-Manhattan. R/M engineers, working in superb laboratories, have perfected or can perfect packings to meet your most exacting requirements, whether you are coping with extremes of temperature, extremes of pressure, or corrosive materials.

Corrosive materials, for example, do not harm R/M "Teflon"* valve stem packings. These packings, supplied in wedge type, angular type, and solid unit rings, are ideal for all kinds of valve stems. They will give you outstanding performance in equipment handling acids, alkalies or solvents. They are recommended for slow-moving reciprocating rods on measuring and blending equipment.

Whatever your packing needs, feel free to call on R/M.

*A Du Pont trademark



R/M Poly-V Drive, more power—less space

No other belt drive delivers as *much* power in as *little* space as R/M's patented Poly-V* Drive. Poly-V's single, endless parallel V-ribbed belt runs on grooved sheaves to mate precisely with belt ribs . . . gives the drive *twice* the tractive surface to deliver up to 50% more power in the same space as a V-belt drive—or equal power in as little as ⅓ the space! This means less shaft overhang . . . a more compact, lighter drive. Single unit design eliminates belt matching problems, helps maintain constant pitch diameter and speed ratios from *no* load to *full* load. Just two cross sections of Poly-V Belt meet *every* heavy duty drive design requirement!

R/M specialists will work with you wherever you need Poly-V Drives, flat transmission or V-belt drives, conveyor belts, hose, molded or other rubber products.

*Poly-V is a registered Raybestos-Manhattan trademark.

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Rubber Lined and Covered Equipment

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Industrial Adhesives

Teflon Tape, Packings, Sheets, Rods, Tubes

Engineered Molded Rubber and Plastics

RM

CIRCLE 119 READER SERVICE CARD

CIRCLE 120 READER SERVICE CARD

Auto Maker Switches to New Thomas Strip Pattern Rolled Steel for Instrument Panels

All four sections of instrument panel are tested for dimensions in checking fixture in Quality Standards Department of auto plant.

Rolled-in Calf-Skin design withstands deep draws, takes paint well.

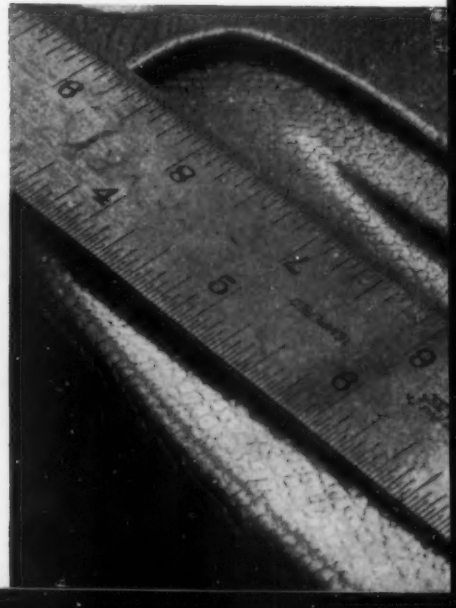
Instrument panels fabricated from Pattern Rolled Strip Steel made their debut in all 1959 models of one of the largest auto makers.

The Pattern Rolled Steel Strip is furnished the auto maker by the Thomas Strip Division of Pittsburgh Steel Co. with a leather grain. Pattern Rolled, in any design that can be drawn with pencil and paper, is available in strip and sheet widths up to 48 inches.

The auto manufacturer specifies Pattern Rolled in five widths ranging from 16 to 23½ inches in coils of steel measuring .041 inch in thickness.

• **Made In Sections**—Presses with up to 70,000 pounds pressure fabricate the instrument panels in four sections—upper right and left and two side panels. After painting and baking, panels are assembled in car bodies on the assembly lines. Testing

Close-up of the calf-skin grain rolled into the steel at Pittsburgh Steel Co.'s Thomas Strip Division.



In fabricating unit of large auto manufacturer, an instrument panel section is examined in checking fixture.

Instrument panel sections are painted and then assembled in the completed auto body.

on checking fixtures assures that both individual sections and complete panel assemblies are accurate dimensionally for a smooth fit during assembly.

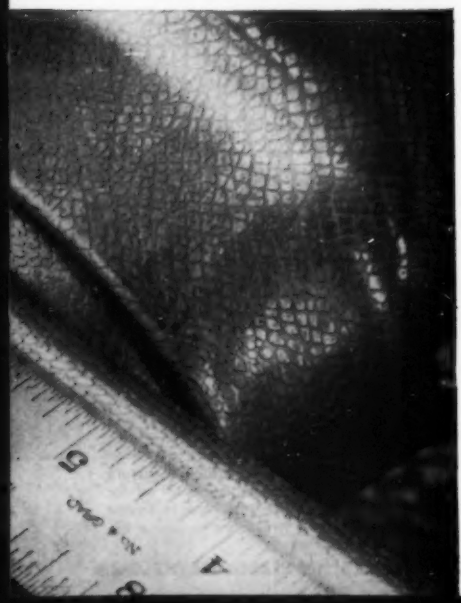
Uniformity of hardness is another prime requirement for steady pressing operations. Surface is critical, too, because flaws would spoil the leather appearance and show through the painting job. Surface quality also plays a part in providing good adhesion between steel and paint.

Drawing quality must be tops. On the upper left instrument panel section, a corner is drawn to a depth of 4½ inches without tearing the steel or even pulling the design out of alignment. Here a correction of .001 inch in the depth of the original pattern yielded the best results. Now Thomas Strip provides coils pattern rolled to a very rigid specification on depth of pattern.

Pattern Rolled Thomas Strip is made from cold rolled steel with all the skill which Thomas has built up in more than 40 years of strip experience. Now Pattern Rolled is available in sheet widths with any pattern you desire rolled into the steel from one edge to the other and from the start of the coil right to the end.

Any fabricator whose product can gain sales appeal from improved appearance will profit by investigating the advantages of Thomas Strip's Pattern Rolled Strip or Sheet. It's available plain, or coated, in many widths with copper, brass, tin, chrome, nickel, zinc or lead alloy. Thomas Strip Pattern Rolled also can be coated with paint, enamel or lacquer on both sides or even on each side in a different color.

Whether you choose a design for product appearance or as an aid to further processing, Pattern Rolled's drawing quality, formability and surface will bring you production economies. Consult a Thomas Strip engineer on how you can use this new, modern metal. Call a Thomas man in the nearest district office.



Thomas Strip® Division

Pittsburgh Steel Company

Grant Building • Pittsburgh 30, Pennsylvania

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WAGNER TYPE DP MOTORS

PROTECTED against corrosion...

PROTECTED against splashing liquids...

WM59-9

Wagner Type DP Motors provide *double protection* that means longer life—more versatility of application. Rugged cast iron frames and endplates are highly resistant to corrosion. Dripproof enclosures are so well designed that these motors can handle many applications that formerly required splashproof motors. These motors pack ample power into little space, are light in weight and are easy to maintain.

SLEEVE BEARING MODELS AVAILABLE. The entire line of ratings is available with ball bearing construction, or with steel-backed, babbitt-lined sleeve bearings of high load carrying capacity that provide quieter operation.

Let a Wagner Sales Engineer show you how these motors can be applied to your needs. Call the nearest branch office or write for Wagner Bulletin MU-223.

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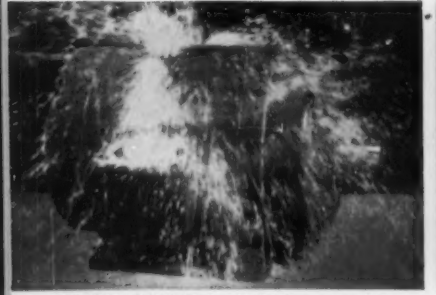

DOUBLY PROTECTED—Air intakes and outlets are positioned to provide complete protection against dripping or splashing liquids. Rugged cast iron frames protect against rough handling and corrosion.

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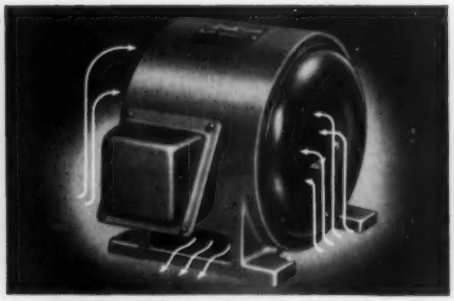
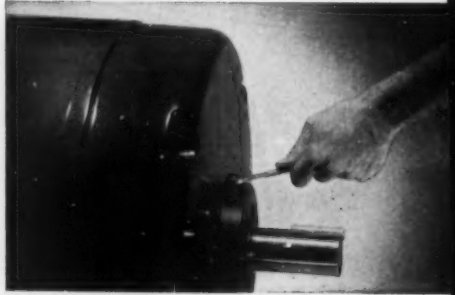


COOLING RUNNING—Specially designed baffles, which protect the stator windings, direct a cooling stream of air through the motor to effectively cool the motor—add to motor life.



CAN BE RE-LUBRICATED—Original factory lubrication will last for years in normal service—but grease plugs are provided to permit re-lubrication that adds years to motor life under severe conditions.

CIRCLE 122 READER SERVICE CARD

PERSPECTIVES

in design and development . . .

Renewal Fees: An Answer for the Patent Office?

The subject of renewal fees for patents has been raised several times in Washington as a possible answer to the US Patent Office's major problem: how to improve efficiency to a point where it will no longer require nearly three years to get a patent. Another problem: inadequate budget. But the renewal fee idea has never been able to sell itself.

What is a renewal fee? The annual fee a patent holder must pay to keep his patent from lapsing. Only two major countries—the US and Canada—do not charge such fees. The fee usually increases with each year up to expiration of the patent. For example: in England, the first fee is due before beginning of the fifth year that the patent is in effect. The amount is 5£. (1£=$2.80) It becomes 6£ for the sixth year; 8£ for the seventh year and increases to 20£ for the 15th and 16th years. Over the life of the patent these annual fees total $462. Filing and issuance fees add another $22.

For the forgetful, there is a three-month grace period within which a renewal fee may be paid, but accompanied by a fine of 2£ per month. In addition, there is a period of three years to apply for restoration of a patent that lapsed unintentionally. Fee for this procedure is 13£, with all intervening rights protected if the patent is restored.

But the British renewal fees are far from the highest. Germany's total fees are $2461 over the 18-year life of the patent. Hungary is next with $1335; the Netherlands next with $915 (increased from $523 in 1957); Austria, $743; Sweden, $710; Belgium, $609; and down the line to Spain with $90. Life of patents in all countries varies from 15 to 20 years.

More Patents?

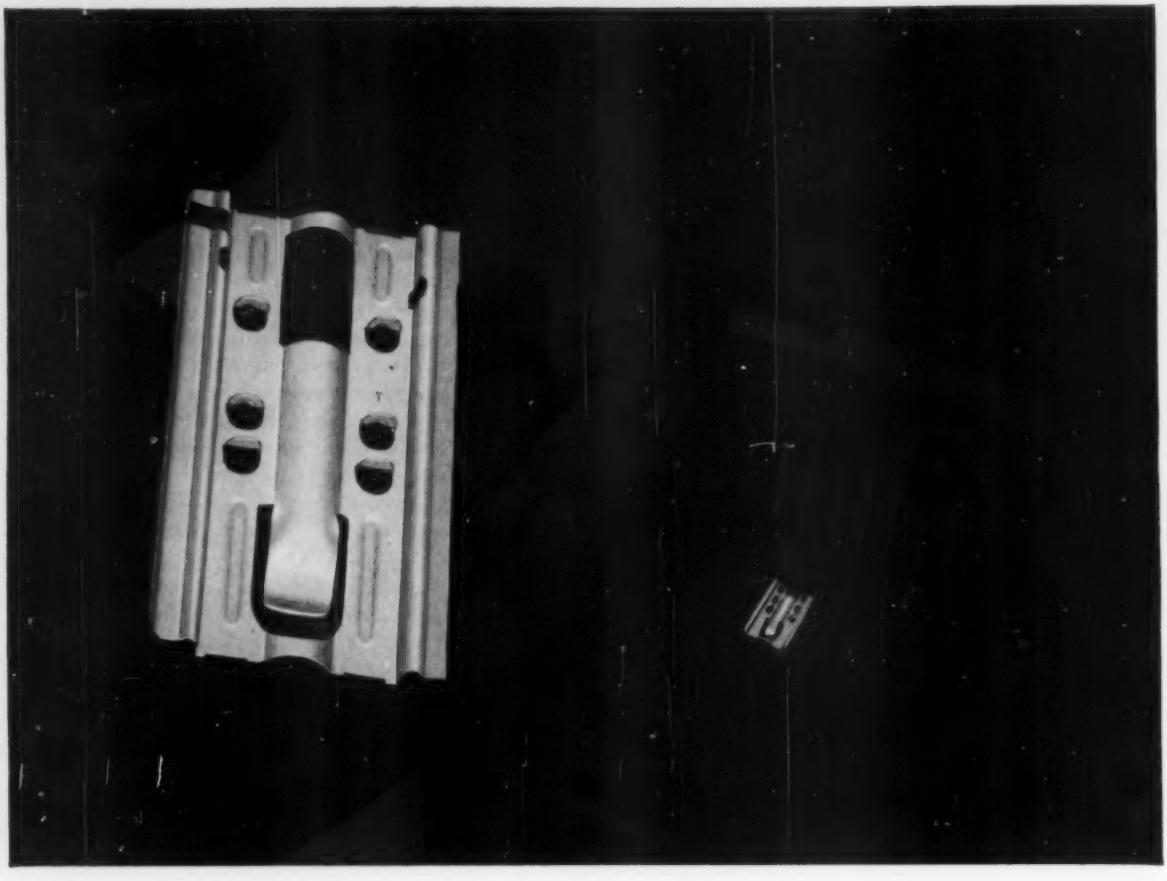
One big argument for renewal fees is to get enough revenue to defray the costs of operating the patent office. Therefore, fees required to get a patent are made low to encourage the filing of patent applications. Heaviest fee burden would fall after a patent had been in effect four to five years.

The two countries which don't charge annual fees, the US and Canada, have the highest fees (not including attorney's fees) for obtaining a patent ($60). Sweden charges $40; Netherlands, $46. Eight countries range from $20 to $26; six countries from $10 to $14; and the remaining are lower.

As to encouragement of the filing of applications and obtaining of patents, this would be difficult to prove or disprove, according to P. J. Federico, examiner-in-chief of the US Patent Office. However, he says, "It should be noted that of the countries listed which have renewal fees, 13—Australia, Austria, Belgium, Denmark, France, Norway, Germany, Great Britain, Italy, Netherlands, New Zealand, Sweden and Switzerland—issued more patents per capita than the US from 1952 to 1956." Also, with its very high renewal fees ($2435), Germany issues almost twice as many patents on a per capita basis as does the US.

In most of the countries listed, receipts to the Patent Office exceed, or almost equal, expenses. Where expenses are greater, they are not too excessive. In 1957 the US Patent Office had expenses of $16.5 million, and an income of only $6.8 million.

What has been the effect of renewal fees on the duration of patents? Partial figures available in the postwar period show a trend. In Germany (1948-57) in the 10th year of the patent term, and after paying renewal fees for eight years, 35% of the patents have been kept in force. In Switzerland for the same period, the figure is 32.3% and in Netherland it is 32.2%. In prewar years these figures were much lower. —Paul Anderson



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Assembly of the SUPER-FILER® *Divide-a-File* mechanism was considerably simplified when the General Fireproofing Company switched to a special SPEED CLIP design. Sightless people do the assembling without former difficulties of fitting spring wires into non-uniform stampings.

With this SPEED CLIP, the "self-adjusting" *Divide-a-File* slides more smoothly back and forth in the channel. Locking in the desired position is more positive, too.

This is another example of how Tinnerman Engineering goes far beyond the original fastening idea—how we work with customer engineering departments to produce better working units. And in the above case, a per-part cost reduction of 50% was achieved. In only 4 months, General Fireproofing had saved enough through lower assembly and parts costs to write-off new tooling needed to produce the SPEED CLIP.

You, too, can achieve savings and improvements like these on your assemblies. Invite your local Tinnerman sales representative in for a discussion of the SPEED NUT methods of better fastening at lower cost. He's listed in most Yellow Pages, under "Fasteners". Or write to:

TINNERMAN PRODUCTS, INC.
Dept. 12 • P.O. Box 6688 • Cleveland 1, Ohio

TINNERMAN
Speed Nuts®

FASTEST THING IN FASTENINGS®

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S.A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.

Product Engineering

HORIZONS

March 30, 1959

Dialects in engineering?

Engineering is vaunted as a profession with its own language, a language that any initiate can understand. Every day we write or draw in specialized characters and forms, more specialized than those of medicine, law, dentistry—for these are all based merely on Latin, while ours are based on the ancient Greek, on Euclid and Pythagoras. The lay press has been having a field day showing a scientist or engineer in front of a blackboard on which are intricate formulas or involved drawings, while its better-trained readers write in to expose errors. We make a great to-do about the universality of the engineering language.

All this is pure hokum. The engineering language isn't universal at all, and hasn't been for years. Part of this is, of course, because some of us are uninformed; part of it because some of us are independent-minded; most of it because—in sharp contrast to our claims—we are not orderly.

Any technical editor worth his salt spends hours making sure the terminology, the Greek and English letters and the drafting standards of articles, are in accord with accepted practice, so the author has some chance of being understood instead of just admired for his incomprehensibility. Any good shopman who changes jobs has immediately to learn the special "standards" of his new employer's drafting department and the personal peculiarities of the engineers bent upon "saving time." Students from high schools in one state who enter a technical university in another find endless variations in everything from lettering standards to formula setups. The author and editor of a technical book are driven beserk in their efforts to provide a universal language.

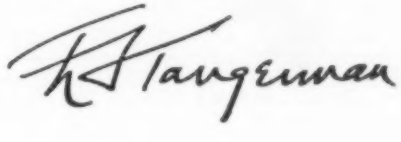
This variety is called a way of expressing personality. Actually, it is nothing but developing local dialect and slang—and in one of the most precise of professions! Dialect is understandable in closed-circle conversation, but not in writing or formal discussion. Slang displays an easy familiarity, but should be a weapon rather than a crutch. Both are often the only means of communication of overripe adolescence.

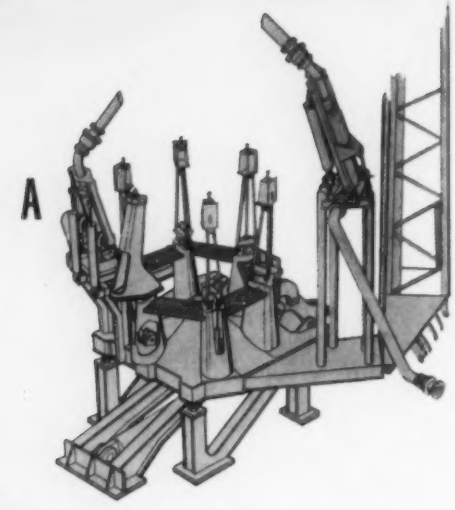
Just as the dictionary provides proper spellings and usage for a language, the American Standards provide standard engineering "language" in formulas and drafting. The tools are available, but have not been used. Some suspect this is a result of lack of pride in profession; we prefer to assume it's just slovenliness.

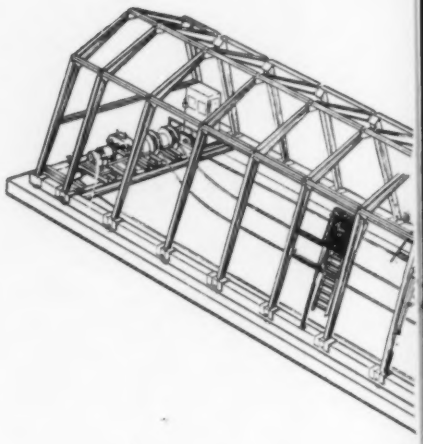
The situation is confused enough so that various groups are beginning to do something about it. For example, the Design & Drafting Council of Delaware Valley is now conducting a 14-week seminar on drafting practice. This is one of the steps this group of dedicated men from industry, education and government has been undertaking for the past three years to acquaint teachers of mechanical drawing in high schools with modern drafting-room practices. Teachers or undergraduates can attend at no cost, for credit. Other areas are also undertaking similar projects—to put engineering into the language it is supposed to have.

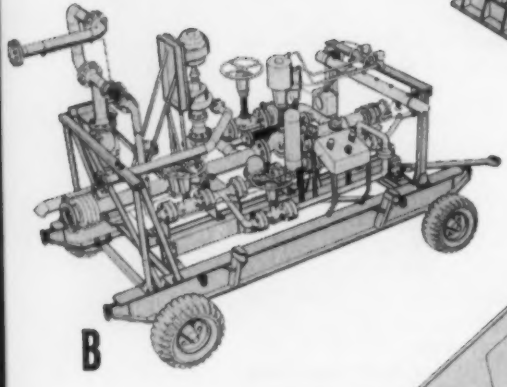
What is the situation in your area, your company, your industry? Do your eastern plants puzzle over data from the western? Does the lab report in terms the engineering department sweats over? Do your prime or sub contractors use a different language? Does the technician or engineering graduate you hire have a strange "tongue"?

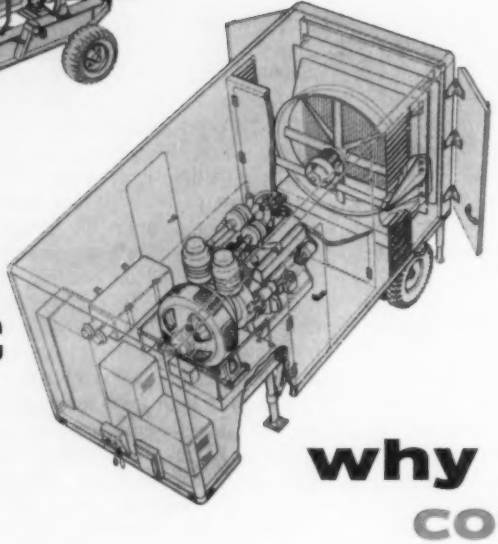
Cooperative effort like that in the Delaware Valley is a first step. If you'd like to take it, we'll provide addresses.

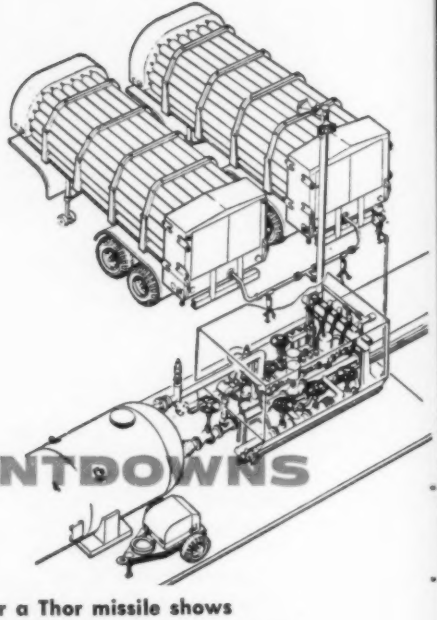








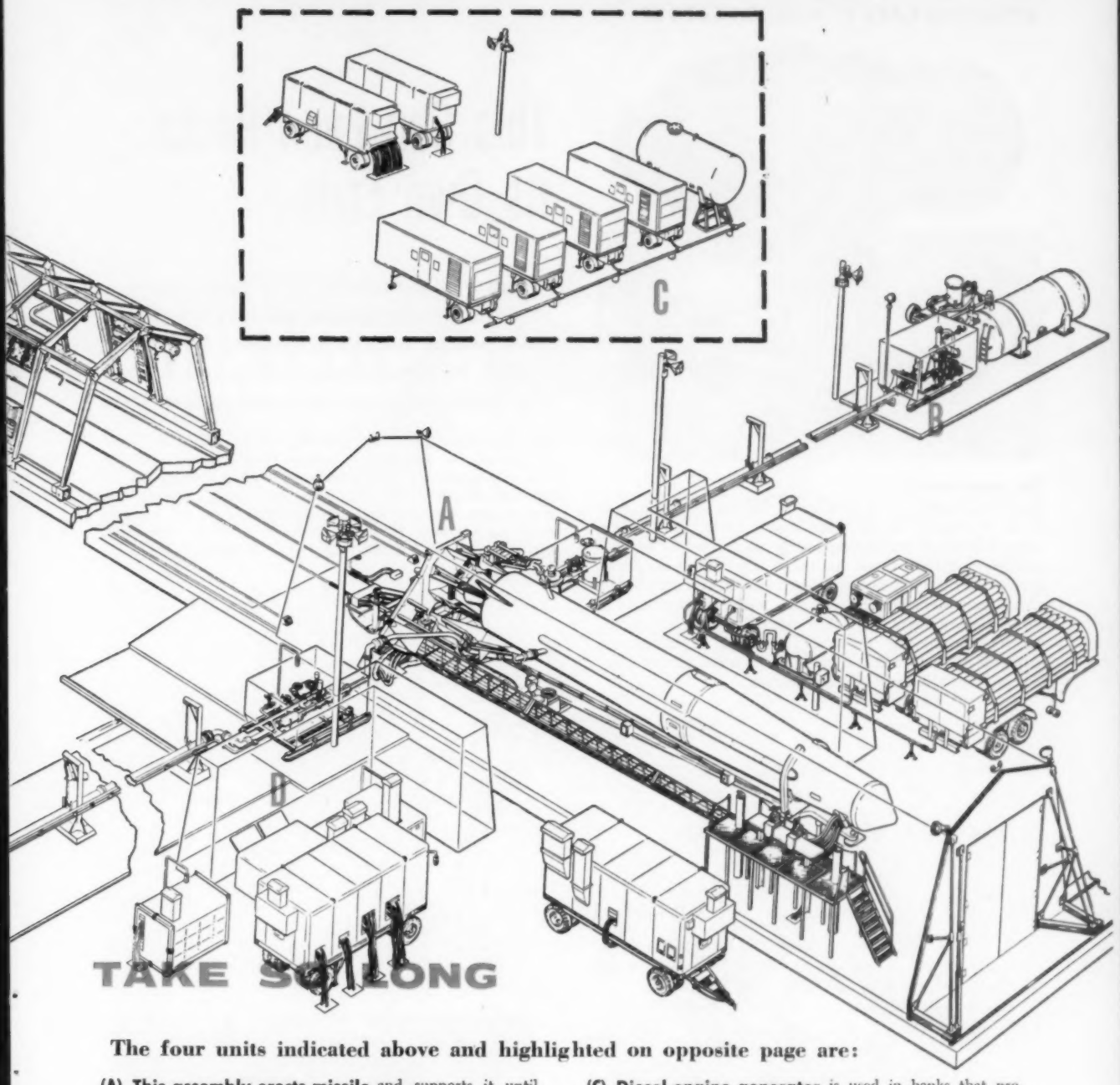




why COUNTDOWNS

Typical launching site for a Thor missile shows complexity of firing operation. Need for mobility, and self-sufficiency in power and fueling, builds up network of equipment—and risks possibility of component and countdown trouble. Over 30 pieces of trailer-mounted equipment are needed to erect, fuel, check out and fire the IRBM. Prime contractor for this WS-315A Weapon System is Douglas Aircraft, Santa Monica, Calif.

IN NEW PRODUCTS



TAKE S[illegible]ONG

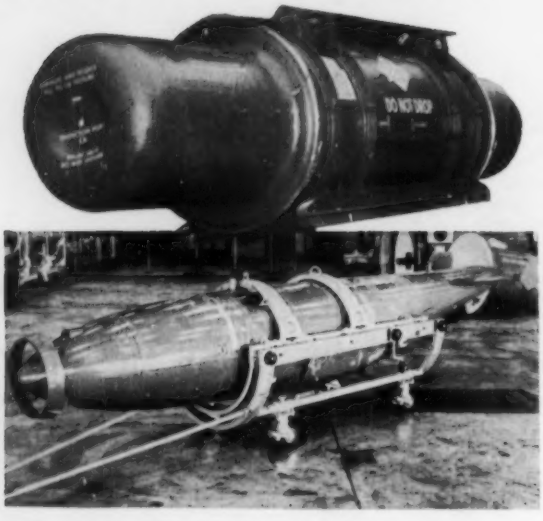
The four units indicated above and highlighted on opposite page are:

(A) This assembly erects missile and supports it until blast-off. To erect, launcher is pinned to horizontal missile; then hydraulic cylinder in lower of the two launchers raises missile and transporter as unit. Supporting legs are retracted at moment of firing. Framework at right is base of umbilical mast that connects missile to ground-support equipment.

(B) Fuel-transfer equipment is located between fuel storage equipment and missile. This unit provides a control center for transferring fuel from tanks to missile fuel cells. Fuels and liquid oxygen used for missile propulsion impose unusually severe operating conditions upon valves, pumps, expansion joints and flexible hoses.

(C) Diesel-engine generator is used in banks that provide tremendous amounts of power needed for hydraulic pumps, electronic equipment, communications, and handling devices. This power is fed through distribution stations and substations to provide the various voltages and frequencies required for ground-support equipment.

(D) Power pack supplies hydraulic power to the erecting-launching mount. Hydraulic cylinders are used to retract the supports for missile and fuel lines, and to raise the launcher to the vertical. If the many steps preceding the launching have gone through without a hitch, the missile is on its own and ready for the firing button.

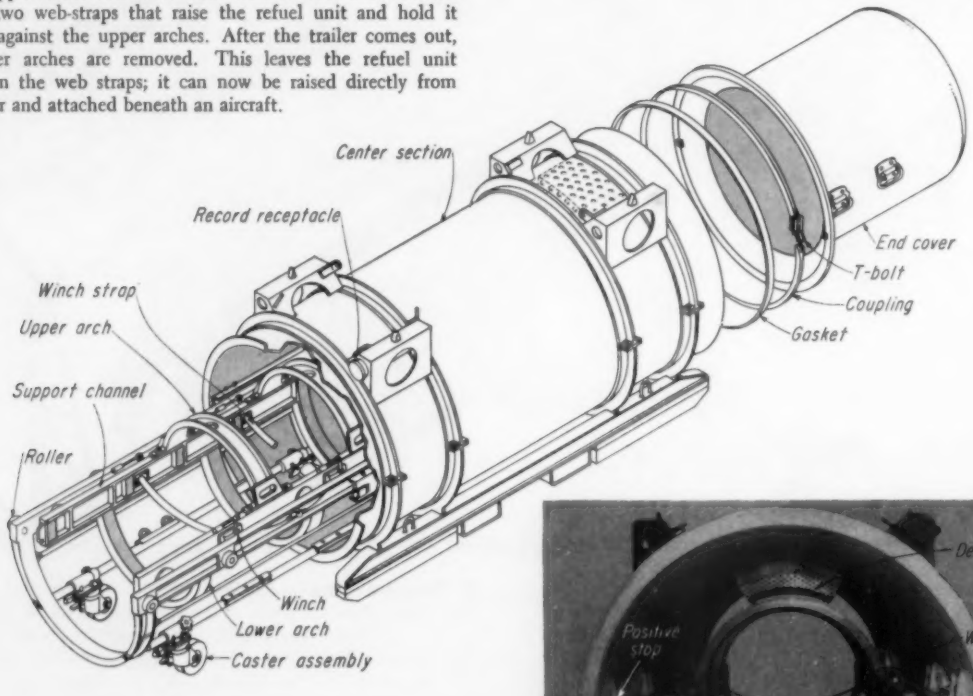


This Can Even Packs Its Own Ends

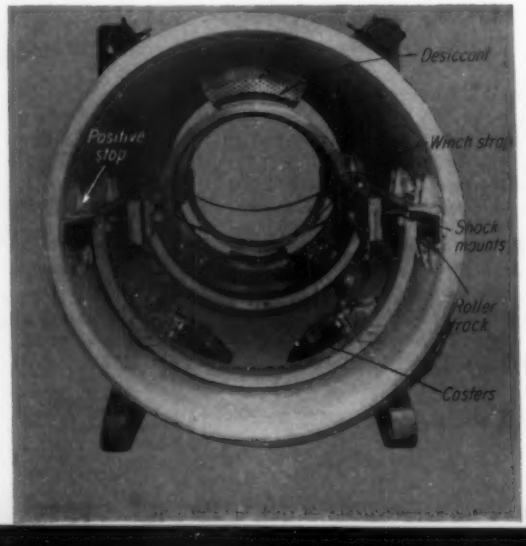
Each of the plastic containers (left, above) carries an aircraft refueler, plus its necessary extras, and also a dolly for moving it to the plane. When emptied, the can's reversible end sections reduce it to half-size and it deadheads back for a refill.

The triple-threat container, consisting of a 4½-by-9-ft center section and two identical end sections, was designed to store, ship and handle a refueling kit up to 16 ft 8 in. long, 30 in. dia, and weighing 2800 lb. Band-clamps quickly release the end sections, allowing stores to be removed on the integral trailer in less than 60 sec. Developed by Harco Container Div of Harbor Boat Building Co, Terminal Island, Calif.

The stores trailer . . .
is carried on each side by three rollers that run in track built-in to the container. Rubber-shear shock-mounts, between the trailer frame and the load-supporting mechanism, isolate the refueling unit from shock. In transit, this unit is supported by two upper arches bolted to trailer frame. Four hand winches control two web-straps that raise the refuel unit and hold it securely against the upper arches. After the trailer comes out, the upper arches are removed. This leaves the refuel unit resting on the web straps; it can now be raised directly from the trailer and attached beneath an aircraft.



Swiveling casters . . . ▶
fold inward, allowing the trailer to be moved into the container on its rollers. Positive stop, at each end of the roller track, has bolt and locknut to position trailer and prevent shifting during transit.



THE ENGINEER'S BOOKSHELF

RICHARD M. KOFF
senior associate editor

A detailed bibliography of technical books for the design engineer, revised as of January 1, 1959

Good reference books are terse, informative, comprehensive without excessive detail, practical rather than theoretical in approach, and well indexed. This definition was used as the guiding principle for the first compilation of an "Engineer's Bookshelf," published in March of 1957, and it applies as well to this revised edition.

Several thousand technical books have been published in the past two years. Of these, most were designed as undergraduate texts, which almost automatically eliminates them from consideration as reference books. Others were in fields too narrow to justify inclusion here. The interested student of a particular field will be led to these specialized texts by the bibliographies and references in more general books.

For the rest, book reviews, expert opinion in the various fields and even the publishers themselves aided in the evaluation. Still, deserving books have been omitted; poor books have been included. Such inequities are inevitable in a compilation of this size. Readers could render invaluable assistance in the preparation of the next edition (probably two years from now) by writing in to advise us of their experience with and opinion of listed (and omitted) books. Your working evaluation is proof of the pudding.

Several changes in subject listings should be noted. The earlier edition's *Plastics* has been broadened to *Nonmetals*. A category for *Computers* has been added. All books of tables have been dropped from the mathematics department. A truly comprehensive list of tables will be found in PRODUCT ENGINEERING for July '57, p 183. The mathematical hobbyist is referred to the Apr '57 issue, p 192.

Well over half the books listed two years ago have had price changes or revisions. These corrections have been made in the entries and almost 150 books published in 1957 and 1958 have been added. To include these newer books we have had to drop the general text on engineering libraries. However, PRODUCT ENGINEERING has published several comprehensive articles on engineering libraries; the reader is referred to two 1958 issues, Oct 6, p 30, and Oct 13, p 72, as well as the original "Bookshelf" article in March '57, p 167.

Space does not permit listing of the many people whose generous contributions of time and advice made this article possible. However, the author wishes to express special appreciation to Miss Rose Boots, chief librarian, Mrs. Jean Guasco, associate librarian, and the staff of the McGraw-Hill Library.

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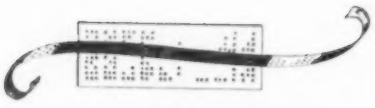

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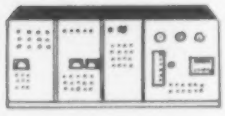

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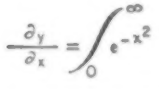

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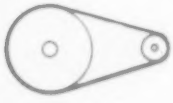

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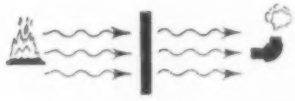

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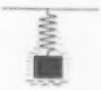

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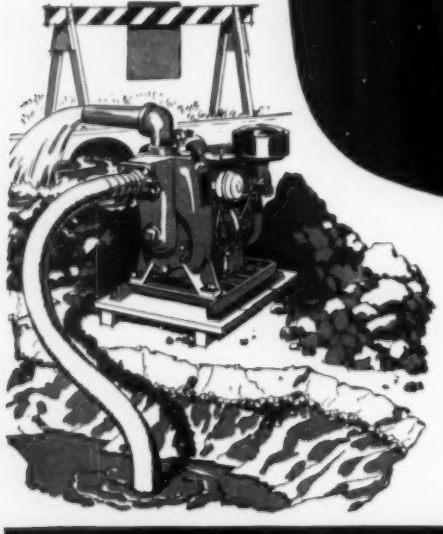

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THIS IS GLASS

A BULLETIN OF PRACTICAL NEW IDEAS FROM CORNING

HOW TO TAKE A SNAPSHOT OF A SATELLITE IN FLIGHT

If snapshooting satellites is on your agenda, contact either Boller & Chivens/-Joseph Nunn, South Pasadena, California, or the Perkin-Elmer Corporation, Norwalk, Connecticut.

In collaboration, these two firms make just what space photographers need. It's called the IGY Satellite Tracking Camera. And, of necessity, it's somewhat larger than the cameras most of you are accustomed to using. Like this.

Twelve of these cameras are now in use around the world. Each is designed to, first, take a picture when fixed on and following the *satellite*. This renders the subjects as a point against a background of streaks from the brightest stars. Then a second exposure is taken with the camera fixed on and moving with the *stars*. This provides the reference for determining the satellite's location.

And us? We provide the mirror blanks for Perkin-Elmer, who in turn handle the complete optical system. (The West Coast firm provides mechanical components and does the assembling.) The blanks we furnish are 31¾" in diameter and 7" thick. They are made from glass No. 7160, the very same glass used in casting the now-famous, 20-ton, 200" disc for the Mt. Palomar Observatory.

The big advantage in using this particular glass is its very low linear coefficient of expansion—23 x 10^{-7} per ° C. Low expansion means a minimum of distortion, a much-appreciated contribution in the complex optics called for in taking pictures of satellites.

These king-sized mirrors lead us quite naturally to remind you that *Corning can do almost anything with glass*. Find out for yourself. Get a copy of "This Is Glass." Use the coupon for quick service.

NEW GIANT GLASS FLASK FOR THE IN-BETWEEN TASK

What intrigues the man in the picture is the *size* of the crystal clear vessel he is examining.

His interest is justified because as far as we know this is the *biggest* all-glass reaction flask on the market. It's new; it measures 18 inches in OD and stands 26 inches high. Capacity is 20 gallons.

We provide this size—along with 5 and 10-gallon versions—for people (maybe you) who need to fill the gap between lab and pilot plant.

You also can get all the trimmings. Like the five-opening all-glass cover that's visible behind the flask. Such covers can be had with pipe flanges, ₮, or socket joints. Accessories include inlet tubes, condensers, blind caps, clamps and thermometer wells. Need one? Just write for details.

This outsized glassware is all made from PYREX brand glass No. 7740—a glass that performs admirably because of the virtues detailed elsewhere on this page.

Which brings us to this diminutive and relatively intricate container known as a Warburg flask. It's quite commonplace to biochemists who use it for measurement of cell respiration and tissue metabolism. It's also a stock item with us.

We call the big ones and the little ones *both* to your attention because it points up the fact that size or shape is a consideration—*not* a limitation—to the skilled glassworkers at Corning.

Investigate by tossing us any one of your tough problems. We'll look for a glass answer and let you know soon what we can do.

PLUMBING FOR POSTERITY

An increasingly popular fixture in labs, hospitals, schools, chem plants, and photoengraving shops is the glass drainline.

With good reason. Glass drainlines are fashioned from PYREX brand glass No. 7740.

This is the glass that ends your worries about corrosion. For example, if you were disposing of waste hot hydrochloric acid, your PYREX pipe would still be around at the end of 200 years.

And glass is smooth; very little chance for block-up in the pipe. If such does occur, however, you can spot the exact point and take corrective action, without having to take down the whole system.

In fact, almost anything made from PYREX brand glass No. 7740 will be around for quite a while because this glass is able to cope with thermal shock and physical knocks, too.

Available in many forms—tubing, rod, pipe, plate, and all kinds of shapes.

Fill in the gaps in your files with these basic references: PE-30, all about glass drainlines; IZ-1, design considerations in glass. Any or all, free. Use the coupon.

CORNING MEANS RESEARCH IN GLASS

CORNING GLASS WORKS 51 Crystal Street, Corning, N.Y.

Please send me: ☐ "This Is Glass"; ☐ Drainline Manual, PE-30; ☐ Design Manual IZ-1: ☐ Info on Reaction Flasks

Name_____ Title_____

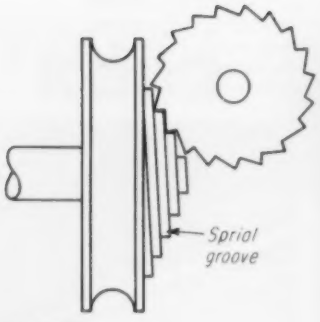
Company_____

Street_____

City_____ Zone____ State_____

12 SPECIAL GEARING

A mixed bag of unusual gear arrangements to answer various tricky design problems. Federico Strasser of Santiago, Chile, is credited for much of this material. A further selection will appear in a coming issue.

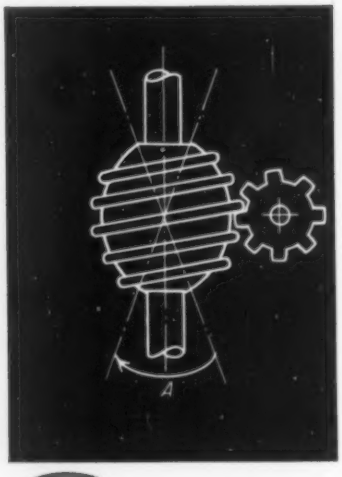


1

Worm gear . . .
has spiral groove. At least two or three pinion teeth are always in mesh.

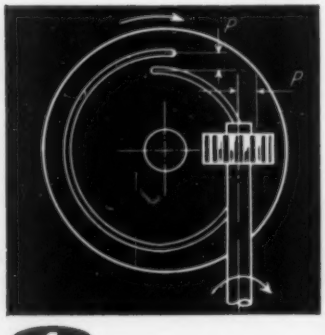
2

Two-tooth pinion . . .
consists of two diametrically opposed, specially shaped teeth. Gear is locked through part of the pinion revolution: by friction type (above), or by cardioid-shape pinion tooth.



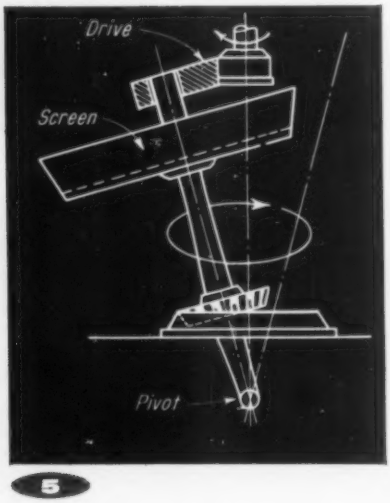
3

Globoid gear . . .
allows shaft to be swung through angle A without varying rotation speed.



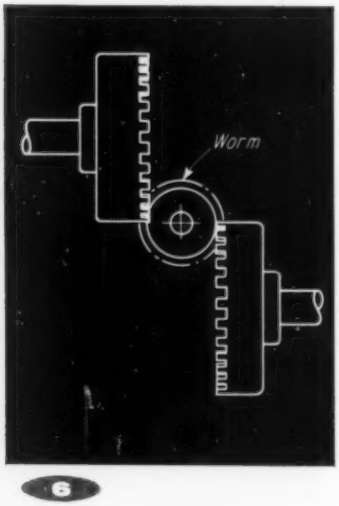
4

Faceplate worm . . .
has spiral ridge on flat face, meshing with worm wheel that turns forward one tooth per faceplate revolution.



5

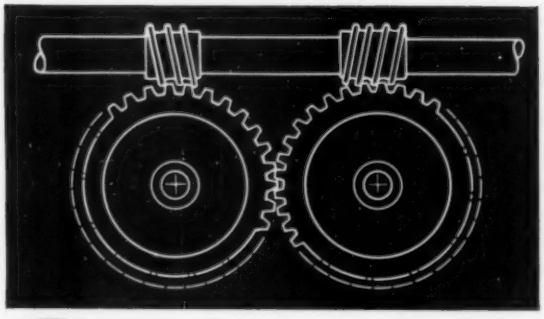
Conical-rotary gear . . .
causes shaft to rotate as it is swung about its pivot. Arrangement is used in reaping machines and other applications where screening action is required.



6

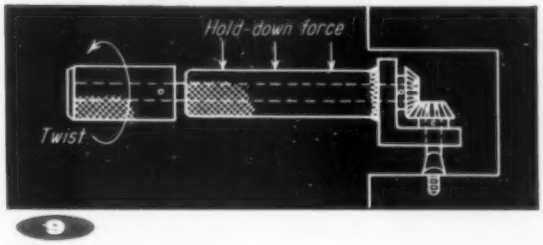
Worm and crown-gear . . .
gives slow, simultaneous feed to two shafts, which rotate in opposite directions. An application for this device is in chaffing machines.

DEVICES



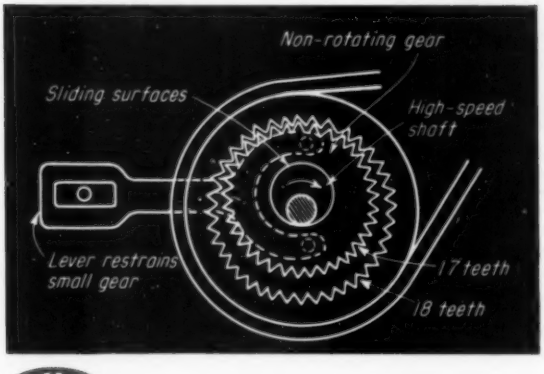
7

Double worms . . .
with opposite-hand threads neutralize end-thrust. Meshing the two gear-wheels gives greater stability to the setup.



9

Right-angle screwdriver . . .
uses two small bevel-gears to transmit torque through 90°.

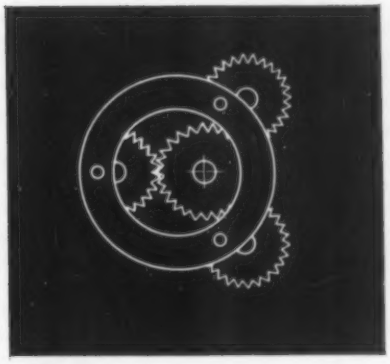


11

"Wabble" gear . . .
provides large speed reduction, depending on numbers of teeth. E.g. for arrangement shown, speed ratio will be 18 to 1—for one shaft revolution the large gear will rotate one tooth space. A 16-to-19 tooth ratio would give a 19-to-3 speed ratio

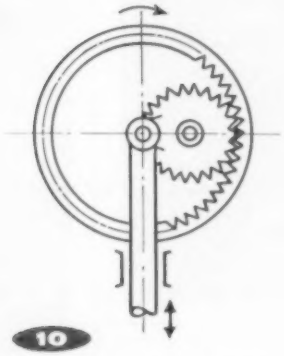
12

Bevel-gear differential . . .
in analog computors solves the equation: $z = c(x \pm y)$, where c is scale factor, x and y are inputs and z is output. Motion of x and y in same direction results in addition; opposite direction gives subtraction.



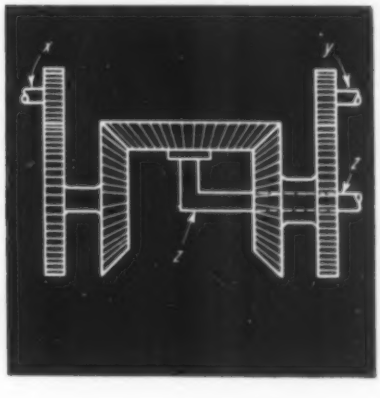
8

Planetary gears . . .
have ring pinned to them at eccentric points. As the planets rotate, the ring-center rotates about a circle with a radius equal to eccentricity of the planet ring-mounting pin.



10

For straight-line motion . . .
epicyclic gear has pinion with pitch diameter equal to pitch radius of sun gear. Pivot-point on pinion, at pitch line, generates straight-line motion as sun gear rotates.



Technical data for gasket design and selection

NUMBER TEN

How to be sure of dimensional stability in fiber gaskets

Dimensional stability in fiber gaskets is obviously important in assembly line production, where warped or shrunken gaskets can cause delays.

Although it is sometimes overlooked, this factor is equally important in gaskets sold for replacement purposes. Such gaskets are usually in dealers' stocks for long periods under varying conditions of temperature and humidity. Often they become unusable or fail to give satisfactory service when they are installed.

Shrinkage and warpage of conventional fiber gaskets stem from the fact that their saturant—usually a glue-glycerine solution—is extractable.

Conventional fiber gaskets on this food mixer dried out and leaked. Switch to Armstrong Accopac eliminated this problem.

This extraction can take place in a short time while the gasket is in service or over a relatively longer period if the gasket is in storage.

A maker of food processing equipment found an economical answer to this problem in Accopac N-852—an Armstrong beater-saturated gasket.

N-852 is made with a nitrile-type rubber binder that is non-volatile and non-extractable in any recommended application. Gaskets cut from N-852 are virtually unaffected by variations in temperature and humidity.

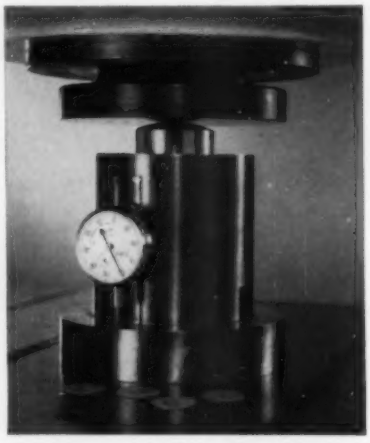
If the fiber gaskets you are using lack dimensional stability, or if they warp or get brittle with age, it is likely that N-852 or one of the other compounds in the Armstrong line will be the answer. We will be glad to suggest appropriate materials if you send details of your problem to us.

How to get lasting gasket seals on aluminum flanges at high pressures and temperatures

Where aluminum flanges are used—particularly at temperatures of 300° F. or above—some new problems in gasket engineering are encountered.

These problems are obviously related to the fact that aluminum's coefficient of expansion is roughly twice that of cast iron or steel.

As heat is applied to an aluminum assembly, expansion has the effect of substantially increasing the unit load above that required for sealing at room temperature. This higher load



Test jig on Baldwin-Southwark Universal Tester determines tendency of gasket samples to crush and extrude under high compression loads.

usually causes conventional fiber materials to crush and extrude, resulting in serious loss of bolt torque.

As the assembly cools to room temperature or below, the contraction of the aluminum often is greater than the gasket material can compensate for, and the result can be leakage.

Engineering studies on problems peculiar to aluminum flanges have been carried on at the Armstrong Research and Development Center for more than a year. These studies show that conventional fiber materials have a marked tendency to crush and extrude under heat and pressure. In fact, for many applications, these materials offer practically no safety factor.

MATERIAL	psi at 300° F		
	10,000	30,000	100,000
A	●	●	
B	●	●	●
C	●	●	

Test samples of conventional fiber materials (A and C) show extensive crushing at 30,000 psi. Accopac AN-890 (B) is not affected at 100,000 psi.

With the use of aluminum growing rapidly—and in applications that impose increasingly severe service conditions on the gasket—the need for a new material becomes obvious.

As a result, Armstrong research has developed a new beater-saturated asbestos gasket material—Accopac AN-890. This new product resists crushing and extrusion even under pressures of 100,000 psi at temperatures up to 350° F. It is already being used in a variety of critical aluminum flange applications.

If you are now working—or planning to work—with aluminum flanges, our experience may be helpful. We will be glad to make suggestions if you will submit details of your problem to us. Write Armstrong Cork Company, Industrial Division, 7103 Irvin Street, Lancaster, Penna.

Armstrong GASKET MATERIALS

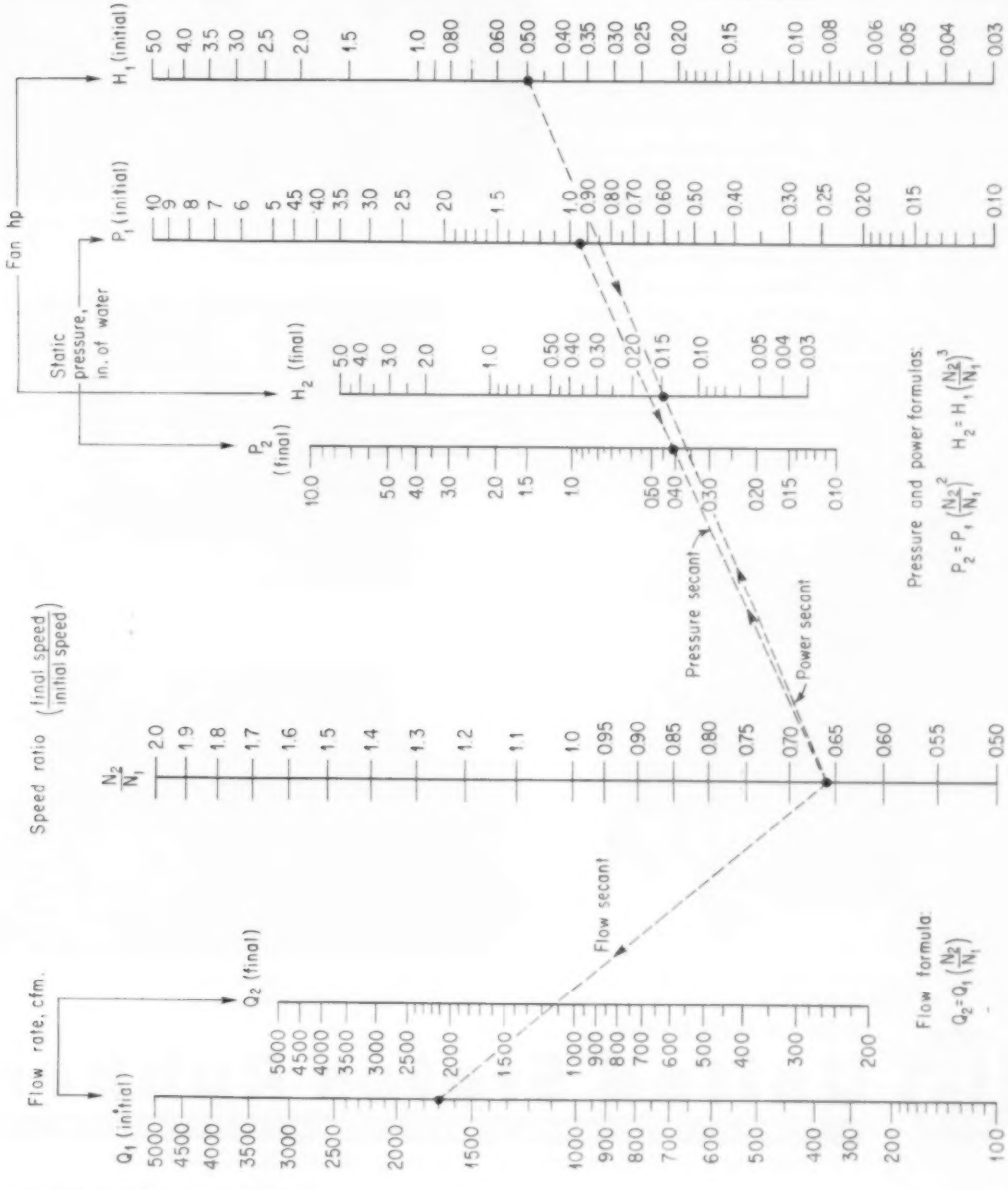
. . . used wherever performance counts

for Changes in Fan Speed . . .

this nomograph

Airflow, pressure, horsepower—these are the variables. When the appropriate secant cuts any two known quantities, it yields the desired third quantity.

IRA J ROY, *applications engineer*
Air Impeller Div
The Torrington Mfg Co
Torrington, Conn



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A Versatile Line of Boots, Connectors, Bellows, Tubes, Air Ducts

If the equipment you make requires

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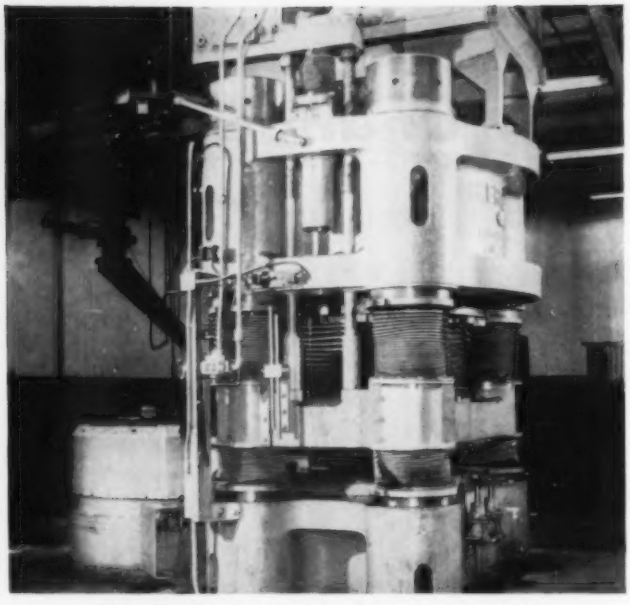
- connectors to take bends or movements in compression or extension
- bellows to move air or be actuated by air
- extremely flexible tubing that will not kink

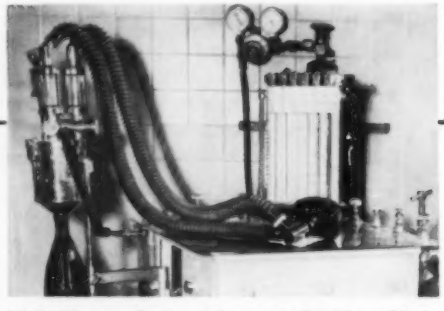
you'll do well to investigate U.S. Multi-Flex.®

Made circumferentially corrugated without molds or other tooling, in inside diameters ranging from ¼" to 48", and engineered to your particular requirements, these products may furnish the answer to difficult-to-solve application problems.

Get U.S. Multi-Flex, plus expert engineering service, at "U.S." Branch Offices, at "U.S." Distributors, or by writing us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.



Multi-Flex laced boots keep dirt and grit out of hydraulic rams. They are laced for easy installation without dismantling press.



Multi-Flex conductive tube—extra-flexible and lightweight—in use on anesthesia equipment.

Multi-Flex boots giving constant protection to the shaft on this brake drum lathe.

Multi-Flex connectors on vacuum filter, taking care of axial movement and misalignment.

Mechanical Goods Division

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Shortcut to POWERS *and* ROOTS

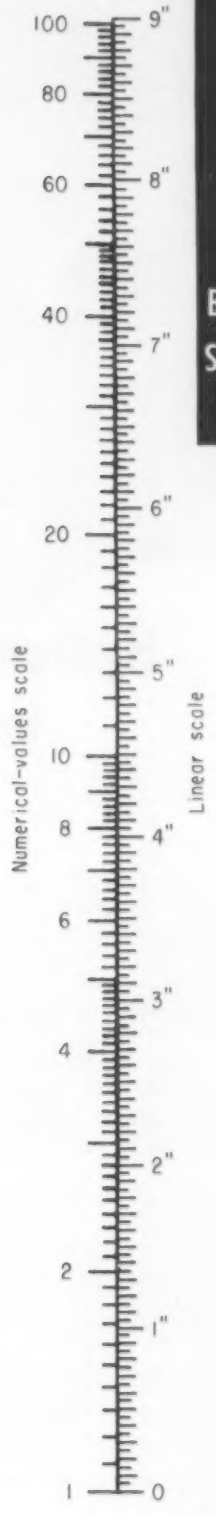
A nomograph that gets around tedious mathematics

DR BISWA NATH GHOSH
International Harvester Co Ltd, Doncaster, Yorks, England

For answers, merely line up numbers and distances on the scale shown here, then multiply or divide, depending on whether you are working either with powers or with roots.

The method gives quick approximations to problems that would otherwise require reference to log tables. This is an advantage in the many cases when log-table accuracy is not needed.

A slide rule will, of course, give answers when whole-number indices are involved. Here, too, the nomograph has an advantage: it is too easy to lose count of slide movements when working out complicated powers and roots.



HOW THE SCALE WORKS

Ex. 1, Required: $2.40^{1.35}$

Linear distance that corresponds to 2.40 on numerical scale = 1.70 in.
Multiply 1.70 by 1.35 = 2.29 in.
Numerical value at 2.29 in. from 1 = 3.26

Therefore $2.40^{1.35} = 3.26$

Ex. 2, Required: $\sqrt[6]{76.4}$

Linear distance from 1 to 76.4 = 8.45 in.
Divide 8.45 by 6 = 1.41 in.
Value at 1.41 from 1 = 2.06

Therefore $\sqrt[6]{76.4} = 2.06$

Ex. 3, Required: 0.31^3

$0.31^3 = (3.1/10)^3 = 3.1^3/10^3 = 29.8/1000 = 0.298$
(From nomograph $3.1^3 = 29.8$)

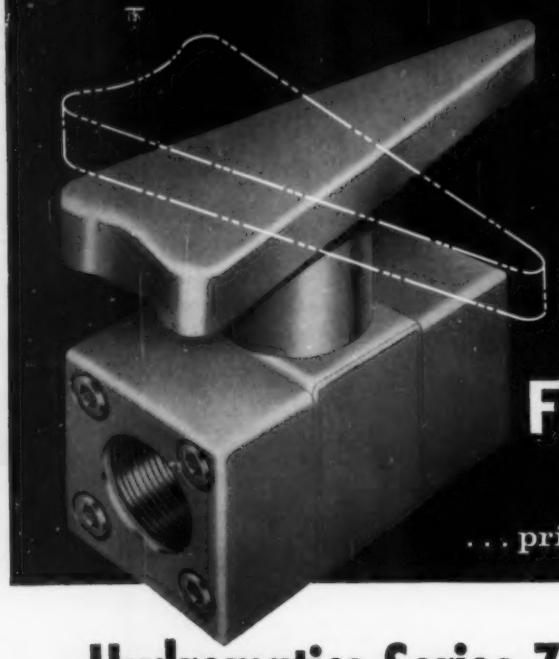
Therefore $0.31^3 = 0.298$

Ex. 4, Required: $\sqrt[1.5]{0.075}$

$\sqrt[1.5]{0.075} = \sqrt[1.5]{7.5/100} = (\sqrt[1.5]{7.5}/\sqrt[1.5]{100}) = 3.82/21.5 = 0.177$ (factors found from nomograph)

Therefore $\sqrt[1.5]{0.075} = 0.177$

Replace your awkward, obsolete needle valves!



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. . . priced no higher than needle valves!

Hydromatics Series 715 Spherical Plug Valve breaks through 150 PSI limitation of ordinary plug valves!

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- **MAXIMUM FLOW EFFICIENCY**... Straight-thru FLO·BALL design has more than twice the flow of needle valves.
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- **REMOVABLE FLANGES**... Replace damaged flanges in seconds—no need to scrap entire valve.
- **VERSATILE SERVICE**... Leak-proof control of air, vacuum, steam, water, fuels, oils, kerosene, alcohol and many other media.

PORT STYLES AND SIZES

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Size	Part No.	Size	Part No.
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1/4	715B1	3/8	715B2

NOTE — Other models are available for service with cryogenic and corrosive media. Also special designs for throttling flow control.

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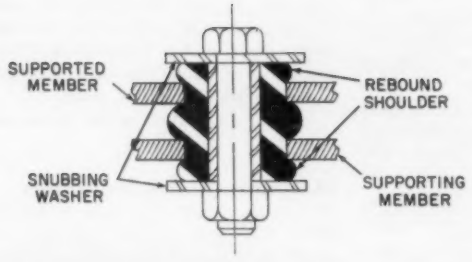
SIGNIFICANT COMPONENTS MATERIALS PROCESSES



Double-extension elastomeric mount . . . has three compression sections for isolation of severe vibratory, shock and related disturbances. Torsional disturbances, distortion and relative motion can be absorbed without loss of stability. Elastomeric flexing element is permanently bonded to steel inner member. Elastomeric end extensions are precompressed at installation to form two rebound shoulders for reverse loads. No lubrication or maintenance is said to be required. About 12½¢ each in lots of 10 thousand or more. **Lord Mfg Co, Erie, Penna.**

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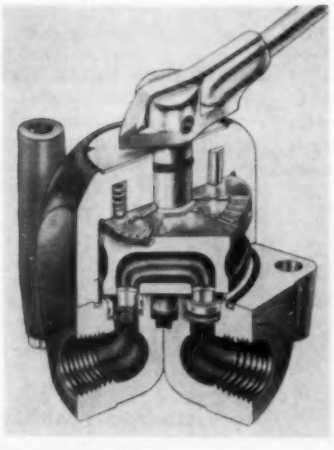
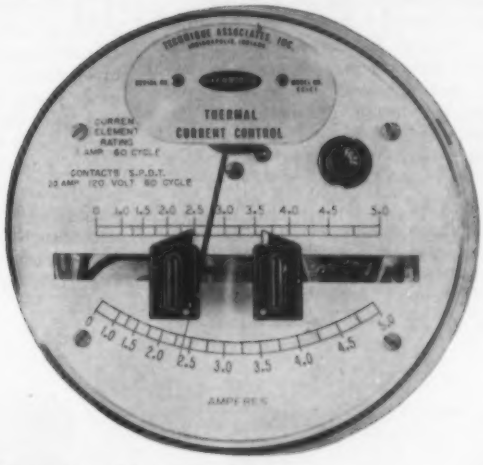


4-way manual valve . . . for oil systems with pressures to 3000 psi. Withstands proof pressures of 4500 psi and surges of 9000 psi. Lightweight valves are made of high-tensile heat-treated aluminum. Moving parts are incorporated in valve so they are constantly lubricated by hydraulic oil. Integral threaded bosses on valve housing simplify mounting. Valve is said to be leakproof and not sensitive to grit or dirt. Lapped metal-to-metal sealing surfaces remain in constant intimate contact. Port sizes range from ¼ to 1 in. NPT with rated flow of from 7 to 38 gpm. List prices range from $40 to $85. Standard units from stock. **Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58.**

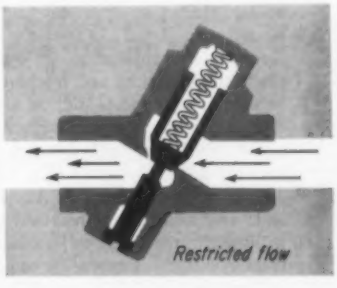
Circle 2, Reader Service Card

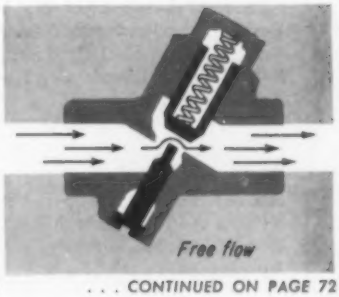


Contact-making ammeter . . . to control electrical currents has thermal-type movement, and detects and controls minute changes in ac currents or loads. Adjustable contacts on indicating pointer actuate built-in relay that will handle loads to 20 amp directly. Control point can be changed or adjusted in field. Control span may be adjusted from 5 to 100% of instrument scale. Ranges from 0 to 5 amp or 0 to 200 amp can be supplied for ac loads without using external current transformers. 0 to 5-amp and 0 to 10-amp dc scales are also available. Controls are supplied in standard w-hr meter cases with plug-in mounting bases. $160 each, FOB Indianapolis. Delivery, 3 to 6 wk. **Technique Associates, PO Box 91, Indianapolis 6.**

Circle 3, Reader Service Card

Adjustable flow . . . valve works with other components of fluid circuit to time, sequence or coordinate operations of circuit. Controls rate at which gas or liquid can flow in one direction through circuit, yet allows free flow in opposite direction. Rated for working pressures of 250-psi max pneumatic, 500 or 2000-psi max hydraulic in temperatures of —40 to 200 F. Made of anodized aluminum, stainless steel and plated steel parts. Seals are oil resistant. Available in ¼, ⅜ and ½-in. NPT sizes, at prices from $4 to $6.75 each. **Industrial Products Div, Westinghouse Air Brake Co, PO Box 36, Wilmerding, Penna.**





Circle 4, Reader Service Card

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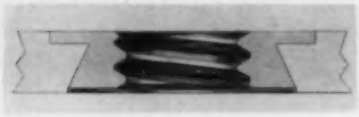
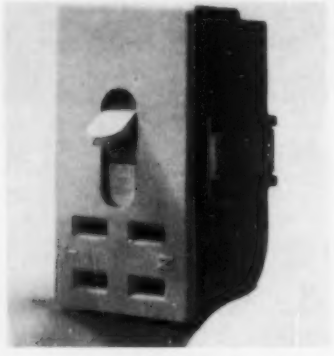


Flush mounting on 2 sides . . .
of thin metal sheet in which it is applied is provided by self-clinching fastener. Flush fasteners are dropped into drilled or punched holes and squeezed by pneumatic, hydraulic or mechanical press. Metal displaced by hex head flows around back-tapered shank, locking fastener. Made in #303 stainless steel with thread sizes from #2-56 to #10-32. Suitable for use in aluminum alloys, brass, copper, cold-rolled steel and similar sheet materials from 0.061 in. thick and up. From stock. List, about $50 per 1000. **Penn Engineering & Mfg Corp, Doylestown, Penna.**

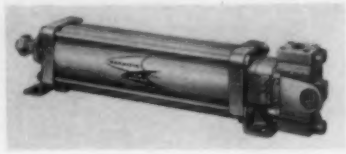
Circle 5, Reader Service Card



Low-amp circuit breakers . . .
are switch-rated for use with motors, appliances, electronic apparatus and OEM equipment. Rated 5 through 20 amp, breakers have application on most 120-v electrical equipment and machinery. Can be used as disconnects and, on some models, as extra convenience outlets, as well as for external circuit protection. Representative model, in ratings of 5, 10, 15 and 20 amp, is $1\frac{1}{8}$ x $2\frac{3}{8}$ x $2\frac{1}{2}$ in. Also available, in 15-amp ratings, is a single-outlet breaker with plug-in receptacle and a double-outlet breaker with two receptacles, one of which has separate terminals to which an external control or electric timer can be wired. Devices are offered with black or white handles and various faceplate finishes. **Federal Pacific Electric Co, 50 Paris St, Newark 1, NJ.**

Circle 6, Reader Service Card

Airpower package . . .
combines airpower cylinder and electrically actuated control valve with built-in speed controls. Installation requires only one air line connection and wiring to the solenoid-



actuated, pilot-operated valve. Squarehead cylinder has rustproof body and induction case-hardened piston rod with hard chromium plated finish. Control valve has reciprocating disk design said to operate even when valve is blanketed by chips or grinder dust or when splashed with coolant. Speed controls are built into 4-way valve port plate. Available in five bore sizes and stroke length to specifications. Shipments can be made within 48 hr. **Hannifin Co, Dept 126, Des Plaines, Ill.**

Circle 7, Reader Service Card

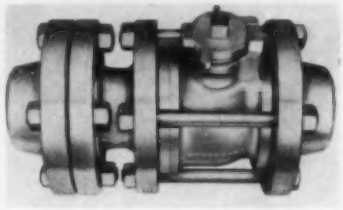
Flathead socket cap screws . . .
are cold forged to compress and densify steel structure. Reported to have deeper sockets with hex running to bottom of socket and free of chips. Sides of head come to sharp, even edge at top with uniform taper. Threads are said to be accurately rolled, and screws to be of uniform length. Fasteners are said to speed assembly and offer closer fit with increased holding power. **Brighton Screw & Mfg Co, 1841 Reading Rd, Cincinnati.**

Circle 8, Reader Service Card

Differential pressure raises . . .
a red button to indicate when differential pressure in a system exceeds a stated value. Unit is activated by differential pressures as small as 5 psi in systems with internal pressures of 5000 psi max. The 1 x $1\frac{1}{4}$ x 2-in. device weighs 0.27 lb. For use in −65 to 275 F systems. Can be used to detect clogging and to report excessive pressure drop in hydraulic or other fluid system. **Aircraft Porous Media Inc, 30 Sea Cliff Ave, Glen Cove, NY.**

Circle 9, Reader Service Card

4-in-1 flange ball valve . . .
serves as either a 150 or 300-lb valve where conditions need not meet ASA dimensions or as a center section to which an appropriate spacer can be added to meet ASA dimensions. Center section of valve is inserted between two standard 150



or 300-lb flanges and flanges are bolted together. Various combinations of seats, O-rings, and body materials accommodate most media within pressure-temperature limitations of sealing materials. **Worcester Valve Co Inc, Worcester, Mass.**

Circle 10, Reader Service Card

Magnetic shields for motors . . .
of the shaded-pole type now permit use of the lower cost units in many servo and other instrumentation applications that formerly required more expensive components. With proper grounding, effective electrostatic shielding is also said to be accomplished. Shield reduces radiated field to under 5 gauss, permitting sensitive magnetic components to be positioned in close proximity. Motor characteristics are said not to be significantly affected by shield's nearness. Shield is nonshock, sensitive, nonretentive and structurally rugged. **Magnetic Shield Div, Perfection Mica Co, 1322 N Elston Ave, Chicago 22.**

Circle 11, Reader Service Card

Heavy-duty liquid springs . . .
equipped with any standard end mountings have energy storage or absorption capacities in both directions up to 1 million-lb force. Built-in fitting permits quick replenishing of liquid with standard grease gun. Adjustable dampening force and time delay return can be built into springs. Standard units are available in 2, 3, 4 and 5-in. dia with up to 2-in. stroke. **Taylor Devices, Inc, 188 Main St, North Tonawanda, NY.**

Circle 12, Reader Service Card

Transistorized positioner . . .
uses printed circuits to provide remote and automatic position control for valves, variable-displacement pumps, machine-tool elements or variable-speed drives. Transmits control signal to shaft-mounted actuator, which may be slipped on control shaft in place of standard hand wheel or lever. Command is set on dial or counter-type setter. Automatic control may be provided by liquid level, dancer roll, pressure transducer or other signal devices. Actuators come in four sizes, developing torques

. . . CONTINUED ON PAGE 74

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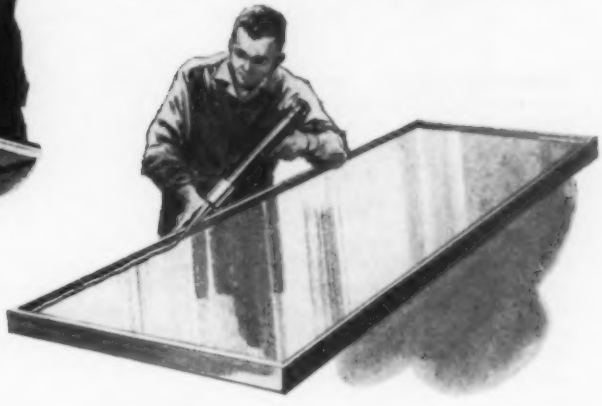

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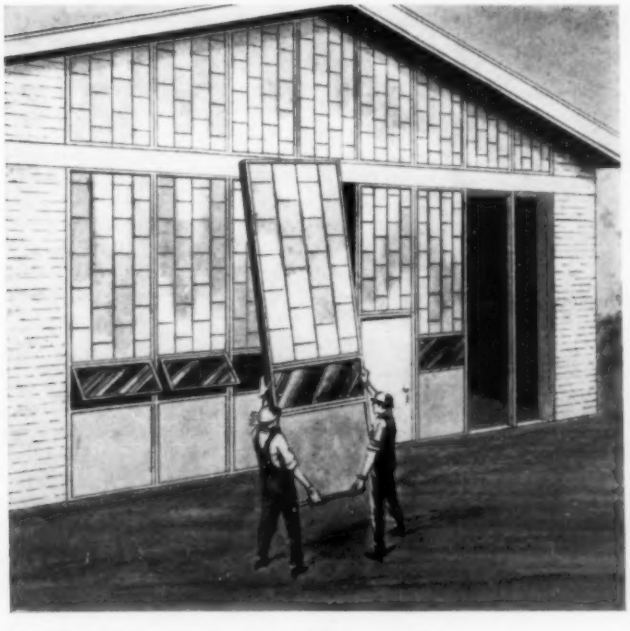

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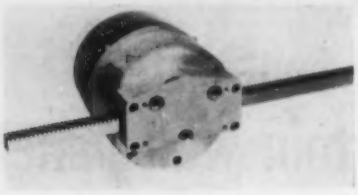


from 1 to several thousand in.-lb. Each size is available in various speeds with full control rotation from 60° to 40 turns. Also provides control for linear actuators, developing thrusts to several thousand pounds with stroke lengths to 40 in. Sells, in quantities of 10 or more, under $100. **Jordan Co Inc, 3235 W Hampton Ave, Milwaukee 9.**

Circle 13, Reader Service Card

Slow-shaft-speed control . . .

is possible with internally geared units. Controls provide electrical signal control when driven by direct coupling to shafts turning less than 10 rpm and will operate when driven from shafts turning as slowly at 2 rpm. All-metal, self-lubricated units have internal gearing available in ratios of 10:1, 5:1 and 2:1. Provided with SPDT snap-action contacts, rated at 10 amp at 125, 250 or 460 v ac. Unit may be used as shaft failure indicator, detecting shaft-failure or reduction in speed by electrical indication. **Winterburn Mfg Co, Putnam, Conn.**

Circle 14, Reader Service Card

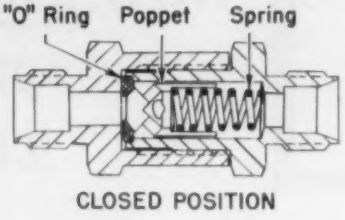
Flow-control servovalve . . .

for hydraulic control systems with pressures from 500 to 4500 psi. Operates on two-stage, force balance feedback principle with an integral filter. May be supplied with standard connector or terminal box to accommodate electrical input. Available from stock in 1, 2.5, 5 and 10-gpm sizes with 1000-psi valve drop and 20-ma input. May be applied to control of automatic machine tools, process valve positioning, positioning and transfer devices and automatic power steering of material handling trucks. **Moog Valve Co Inc, East Aurora, NY.**

Circle 15, Reader Service Card

Poppet check valve . . .

maintains full flow with low pressure drop. Adaptable for use with wide range of pressures. Major application is on instrument, process and control lines to allow flow in one direction instantly and automatically stop flow in reverse direction. Assembly said to eliminate chatter. The 2⅛-in. device is furnished in brass, stainless steel, Monel, aluminum, nylon and other machineable materials. Available



with end connections to permit installation directly to tubing or for other types of installations. **Nuclear Products Co, 15635 Saranac Rd, Cleveland 10.**

Circle 16, Reader Service Card

Flexible hose for 600 F use . . .

for short periods, is said to last almost indefinitely at 350 F and to resist extremes of chemical attack. Hose is result of development that makes possible extrusion and fabrication of large-diameter hose from Viton, an elastomer. High strength and resistance to abrasion is achieved by a jacket of Dacron polyester fiber. Hose design gives min burst strength of 600 psi. Can be used with low-pressure steam, hot water and condensing steam. Available in 1 to 4-in. ID sizes, with or without couplings. **Thermoid Div, H K Porter Co Inc, Tacony and Comly Sts, Philadelphia.**

Circle 17, Reader Service Card

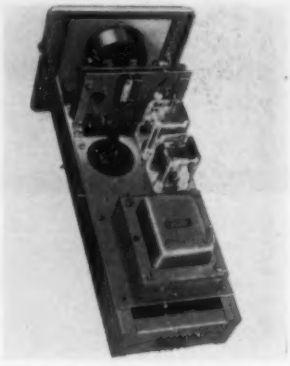
Single-shot switches . . .

are hermetically sealed, temperature-sensitive units, available in normally open and normally closed, single-pole types. Factory-preset for activating temperatures from 113 to 1500 F. Rated for 4, 10, 50, 100 or 300 amp. Operates in temperatures of —100 to 1500 F, depending upon activating temperature and unlimited altitude. Withstands shock of 250 g for 2 to 4 millisec and vibration of 2 to 20,000 cps at 40 g. Meets specifications of MIL-E-5272B for humidity. In ceramic case. Applications cover field of fail-safe devices. **Thermocal Inc, 1629 Colorado St, Santa Monica, Calif.**

Circle 18, Reader Service Card

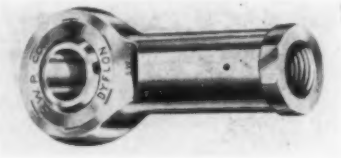
Multipoint-monitoring . . .

system on a continuous basis detects and furnishes warning when temperature at any protected point reaches a preselected high or low limit. Consists of monitor modules, each of which receives inputs from 10 thermistor probes, and an alarm-indicator module. Up to 10 modules, 100 points, can be handled by one alarm-indicator module. Can monitor temperatures between —25 and 600 F. Sensing circuits employ no sampling or scanning devices. Sensing points are terminated in a multi-channel bridge network that receives and



monitors all inputs simultaneously and continuously. At present, monitoring system is available only with manual means for identifying and indicating temperature of trouble point. For rack or panel mounting. Modules measure 5¼ x 11¼ in. deep. Fitted with plug-in connectors. System operates on 60 cps, 110 or 220 v input. Alarm circuit is rated at 5 amp. Cost is said to be equal to or lower than presently available monitoring systems, continuous or scanning of equivalent function and capacity. **Fenwal Inc, Ashland, Mass.**

Circle 19, Reader Service Card



Self-lubricating bearings . . .

are recommended for applications requiring low coefficient of friction, long service life without lubrication and high dynamic load-carrying capacity. Self-aligning bearings are available in plain and rod-end types in bore sizes from $\frac{3}{16}$ to 6 in. dia. Rod-end types are offered with externally or internally threaded shanks. Chrome alloy steel, stainless steel and plastics are among materials used to suit varying load requirements. **Southwest Products Co, 1705 S Mountain Ave, Monrovia, Calif.**

Circle 20, Reader Service Card

Fhp gearmotor . . .

for universal and induction applications is available in ratios from 10:1 to 60:1. Consists of gear reduction unit in combination with an induction or universal motor. As a universal ac/dc or shunt motor, unit is rated from 1/70 to ¼ hp and torque output of up to 60 in.-lb, depending upon ratio. As an induction unit, available in 2-pole and 4-pole models

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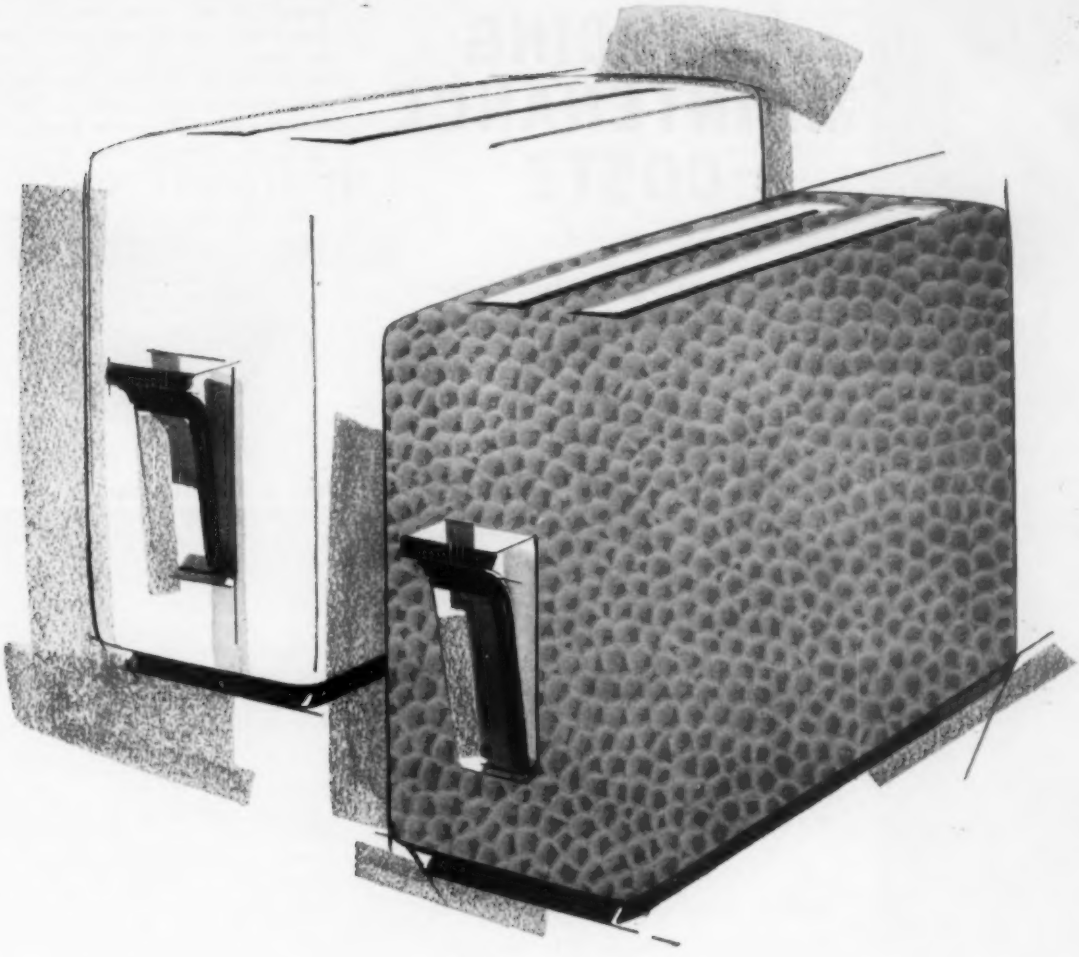

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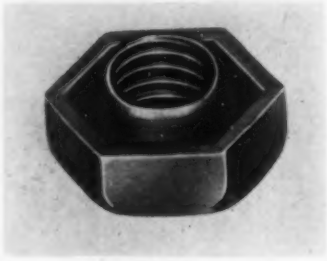
from 1/70 to 1/15 hp, with same range of torque ratings. Permanently lubricated and sealed ball bearings, machined zinc die-cast housing with mating parts telescoped to hold close tolerances and dynamically balanced armatures and rotors are standard. Mounting pads are provided on gear unit for coupling. Gear unit can be mounted in various positions. **Howard Industries Inc, 1700 State St, Racine, Wis.**

Circle 21, Reader Service Card



Nut is 40% lighter . . . than current NAS high-strength self-locking nuts. Minimized hex body section has been fortified with base ring for good thread load distribution and to provide adequate bearing area for use with soft metals, such as aluminum. Locknut is said to offer wrenching dimensions two socket sizes smaller then equivalent NAS or AN nuts. Hex dimensions are said to be compatible with standard wrenches. Low-height nut can be used to develop full strength of 160,000-psi bolts, including short-thread NAS series. For temperatures up to 550 F, parts are heat-treated carbon steel, cadmium-plated with a supplementary molybdenum disulphide dry-film lubricant. A286 corrosion-resistant steel is used for temperatures up to 900 F. Both series are available, at present, in sizes 10-32 and ¼-in.-28. Designed in sizes 4-40 through ⅜-in.-24. **Elastic Stop Nut Corp of America. 2330 Vauxhall Rd, Union, NJ.**

Circle 22, Reader Service Card

Hysteresis ac motors . . . in sizes 10 and 11 for 26, 55 or 115-v, 400-cps operation are for use in ambient temperatures of −85 to 257 F. The 6-pole units have pull-in torque of 0.12 in.-oz and operate at 8000 rpm. Motors measure 1 1/32 in. long. **Western Gear Corp, Electro Products Div, 132 W Colorado St, Pasadena, Calif.**

Circle 23, Reader Service Card

4-speed transmission . . . with specified gear ratios to max reduction of 9.4:1 offers two speeds forward—two speeds reverse, or four speeds for in-

(Continued on page 80)

Tone Up Your System

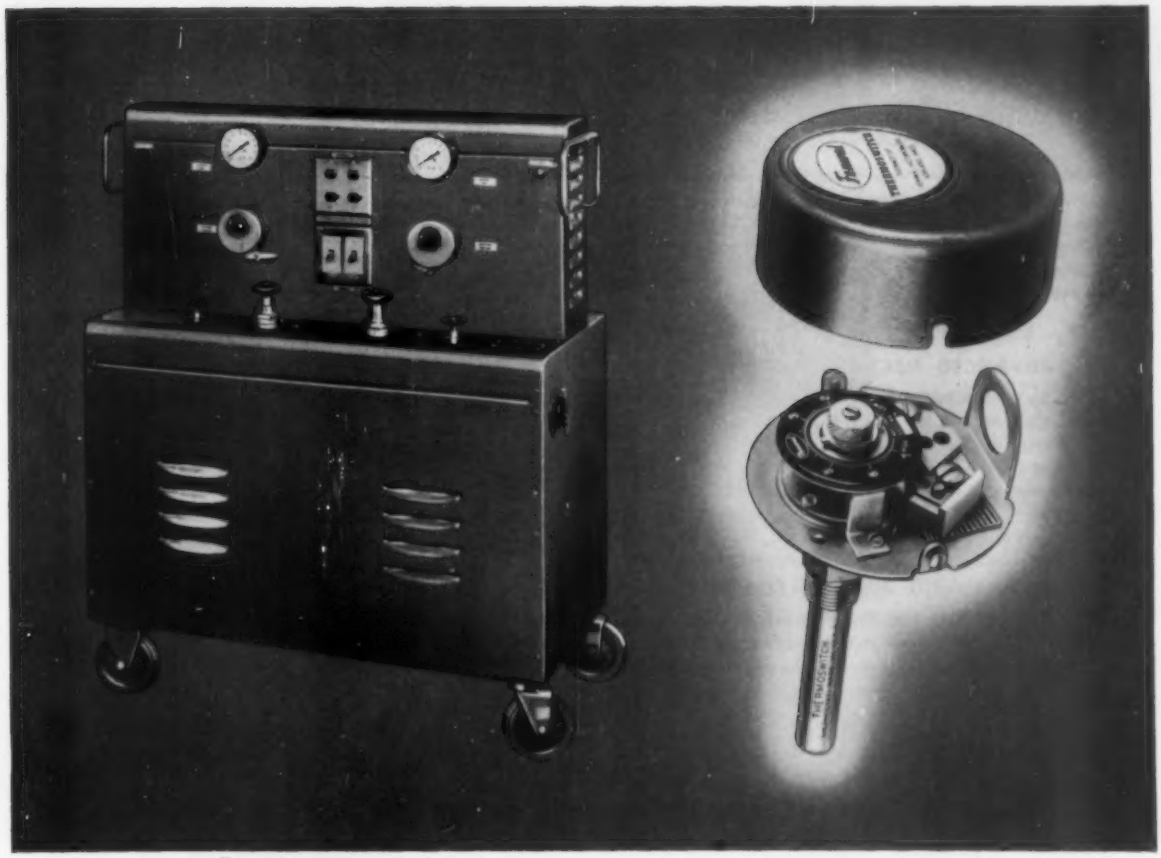
Many a manufacturer reports that installing a Fenwal THERMOSWITCH unit resulted in *immediate improvement in the performance of his equipment!*

"Immediate" is right. Rapid response is one big advantage because the outer shell is the temperature sensing member. Extreme sensitivity — within a fraction of a degree — is another. That's because the slightest movement of the shell opens or closes contacts. And within its operating range, a THERMOSWITCH unit is field adjustable, yet has a sealed tamper-proof assembly to retain its sensitivity and precision through a long, useful life. Operating range is from −100°F to 600°F . . . *three to five times that of any ordinary thermostat!*

Applications for easy-to-install THERMOSWITCH units are virtually limitless . . . not only to "tone up" existing thermal systems, but to insure the long, reliable life that industry requires. For more facts write to Fenwal Incorporated, 213 Pleasant Street, Ashland, Mass., asking for a catalog, a sales engineer, or both.

. . . *any thermal system . . . with a sensitive, precise THERMOSWITCH® unit*

In this Sterlco Control, an automatic self-contained unit for heating or cooling water to maintain a constant temperature while circulating it continuously through a plastics forming mold, "a Fenwal THERMOSWITCH unit, No. 17800 with dial and knob, fills our requirement for a sensitive, reliable, long-lasting thermostat." So says Sterling, Inc., Milwaukee, Wis.



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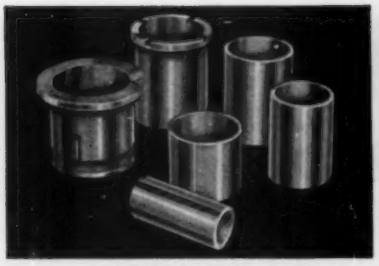

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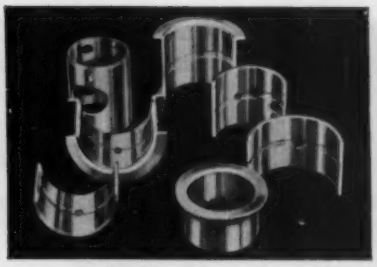

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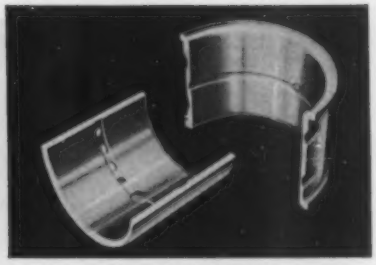

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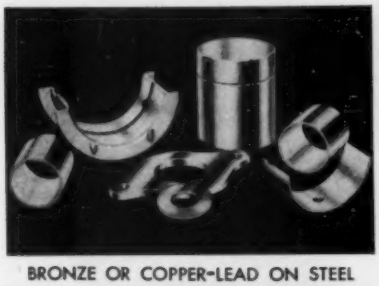

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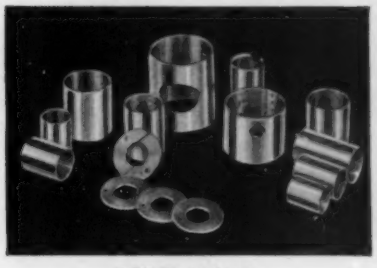

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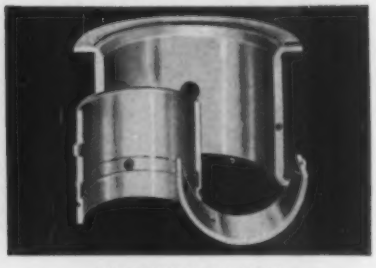

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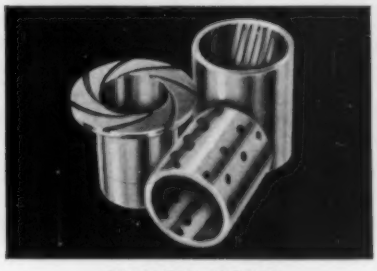

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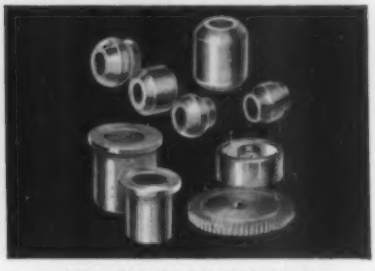

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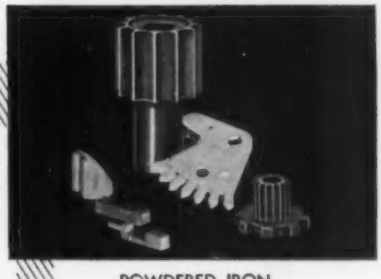

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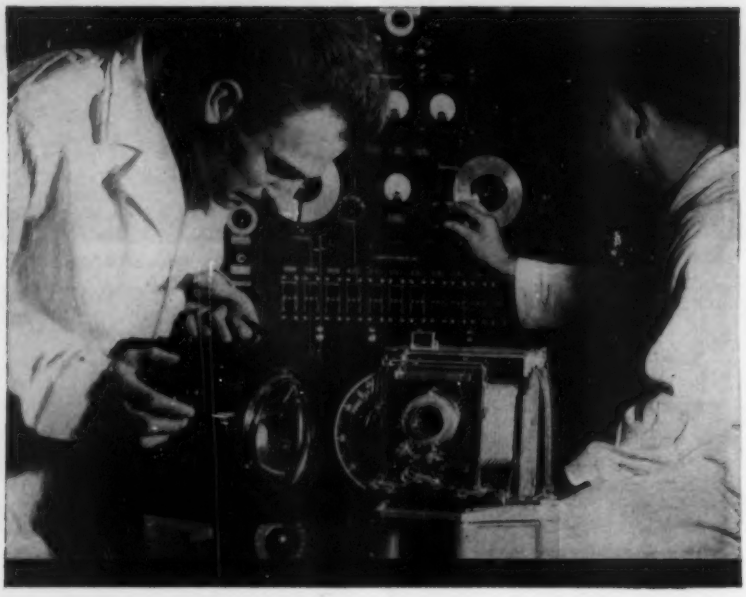

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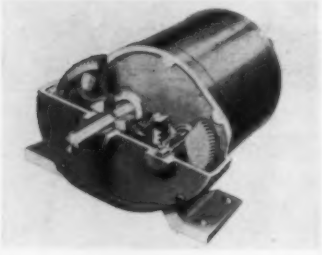

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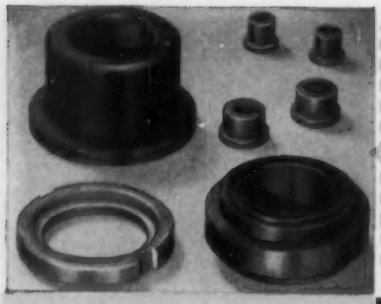

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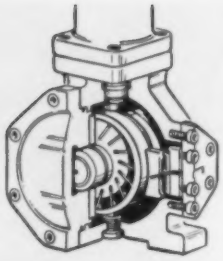

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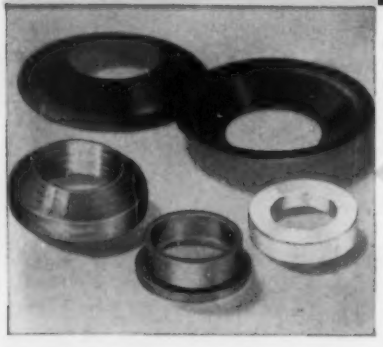

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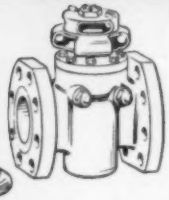

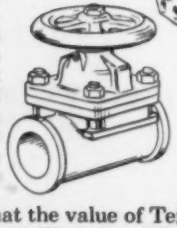

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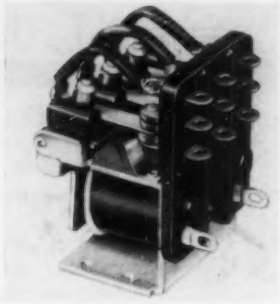

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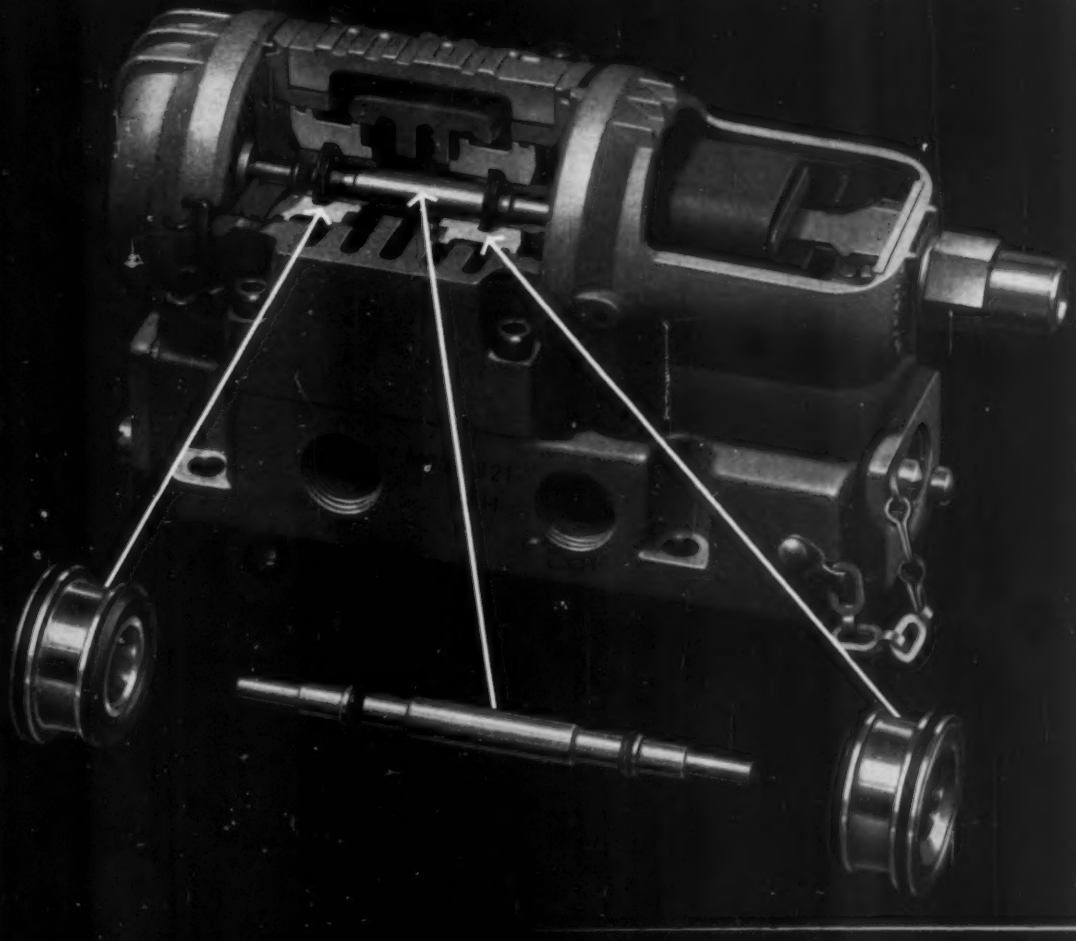

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MILLIVOLTMETERS—Catalog C10-1, 28 pp. Covers operating principles, specifications, features and ordering information on noncontrol and control millivoltmeters. Minneapolis-Honeywell Regulator Co, Wayne and Windrim Aves, Philadelphia 44.
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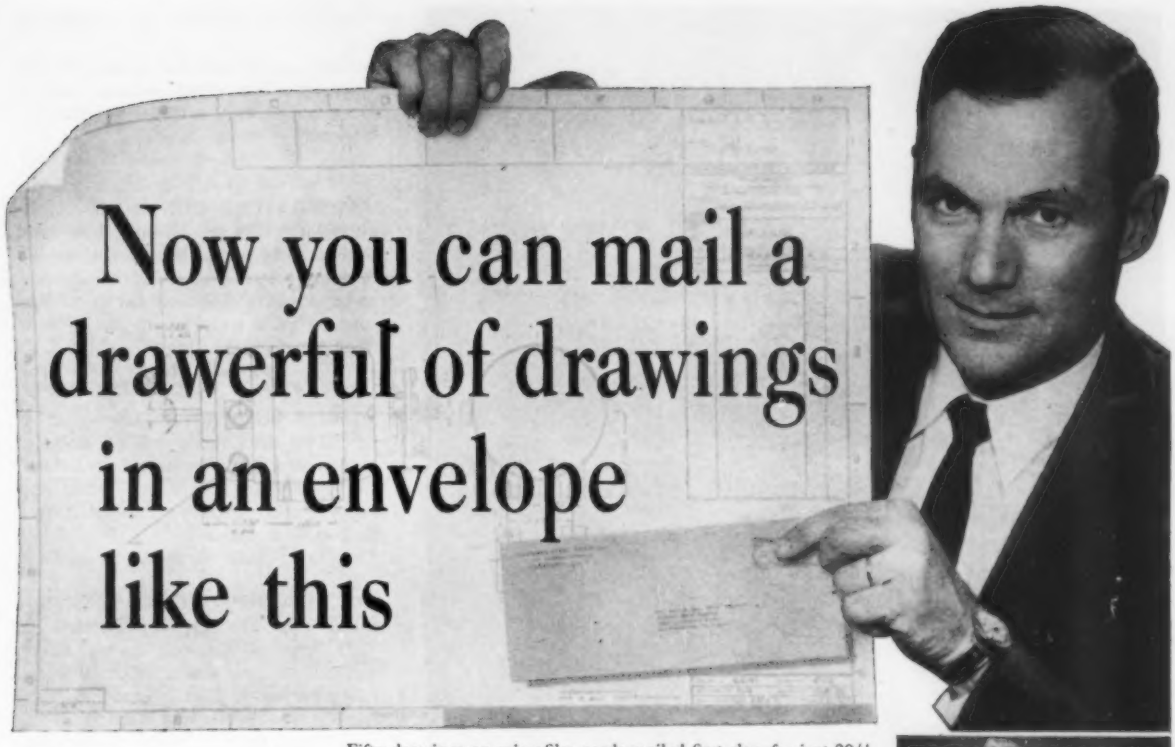

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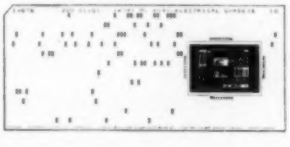

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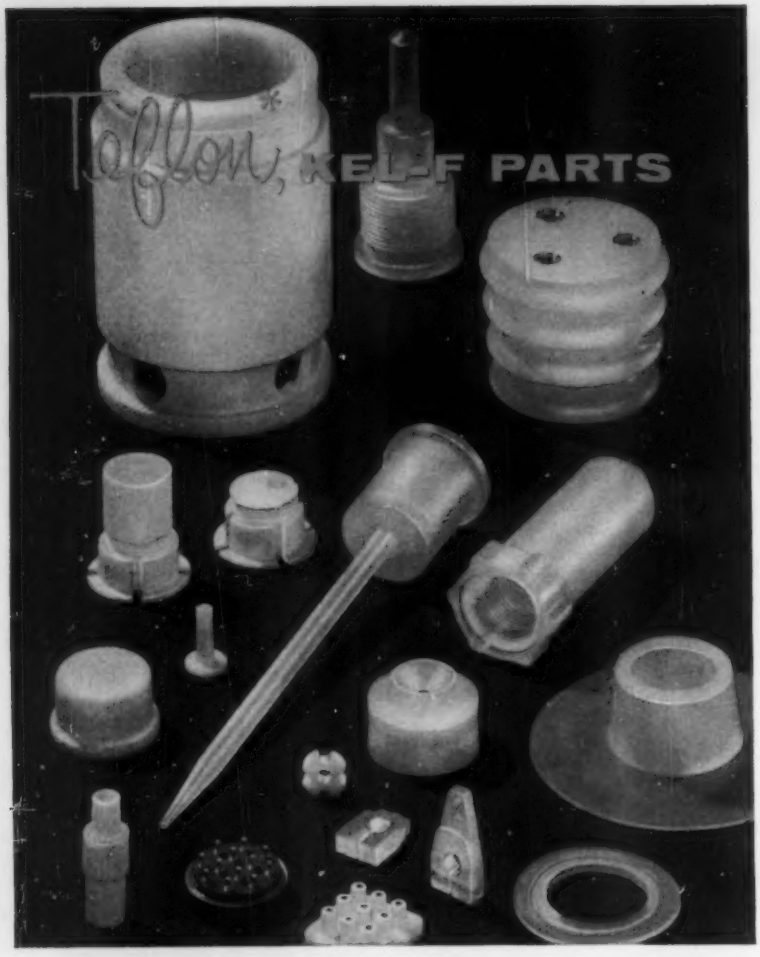

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leveling mount and descriptions of two types of self-contained leveling mounts. Unisorb Div, Felters Co, 210 South St, Boston.

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TEMPERATURE CONTROLS – Brochure MC-177, 8 pp. Describes how units operate on differential expansion of metals, operating specifications and dimensions, and available modifications and special features. Fenwal Inc, Pleasant St, Ashland, Mass.

Circle 43, Reader Service Card

SILICON RECTIFIER–Data sheet, 2 pp. Gives descriptions and specifications on power rectifiers. Presents electrical and mechanical characteristics and performance data. Syntron Co, 240 Lexington Ave, Homer City, Penna.

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IMPULSE-COUNTING DEVICES–Brochure, 4 pp. Describes and illustrates all types of impulse-counting devices. Gives construction information, electrical characteristics, specifications. Landis & Gyr Inc, 45 W 45th St, New York 36.

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ELECTRONIC FEED REGULATORS AND LEVEL CONTROLS–Bulletin 13552D, 6 pp. Covers basics of operation of the regulators and level controls, installation and descriptions of devices. With installation and wiring diagrams. Industrial Instruments Inc, 89 Commerce Rd, Cedar Grove, NJ.

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PREVENTING CORROSION–Bulletin 93XG, 4 pp. Describes metal coatings bonded to steel base by metallizing to protect against oxidation. Pictures some typical applications. Metallizing Engineering Co Inc, 1101 Prospect Ave, Westbury, NY.

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FLEXIBLE COUPLINGS–Catalog CP1-57, 8 pp. Contains dimensions, list prices, hp ratings and standard specifications. Cutaway diagrams and dimensional drawings illustrate construction and size. Acme Chain Corp, 821 Main St, Holyoke, Mass.

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TILTED-WHEEL CASTERS–Catalog sheet 122458, 2 pp. Specifications and dimensions. Faultless Caster Corp, Dept PR, Evansville 7, Ind.

Circle 49, Reader Service Card

VARIABLE-SPEED DRIVES–Bulletin G-5812, 8 pp. Mechanical construction features, condensed drive specifications, available speed variations and accessories

(Continued on page 87)

for mechanical speed drives. Reeves Pulley Co, Div Reliance Electric and Engineering Co, Columbus, Ind.

Circle 50, Reader Service Card

GROUND FLAT STOCK—Bulletin M80, 16 pp. Describes characteristics of ground tool steel, precolored blue for oil hardening and maroon for air hardening. Also features low-carbon ground flat economy grade. Brown & Sharpe Mfg. Co, Providence 1, RI.

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ADJUSTABLE-SPEED DRIVES—Catalog WRB-58, 4 pp. Describes operation and application of wide-range, adjustable-diameter, wedge-belt sheaves. Installation and mounting dimensions are listed. American Pulley Co, 4200 Wissahickon Ave, Philadelphia 29.

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COMPONENT ASSORTMENTS—Bulletin 162, 2 pp. Describes three assortments of precision resistors and tantalum capacitors, offered in 5-drawer, 40-compartment plastic case. Ohmite Mfg Co, 3670 Howard St, Skokie, Ill.

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CIRCUIT BREAKERS—Catalog, 4 pp. Specs and construction details. Wood Electric Co, 244 Broad St, Lynn, Mass.

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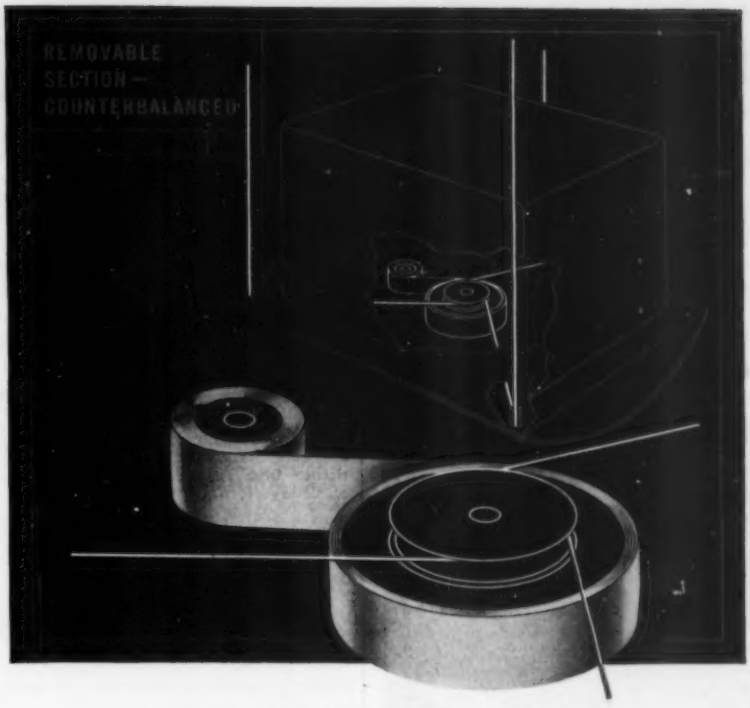

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"Lubrication Problems in High-speed Gears," J W Dern, Steel Products Engineering Co, Lubrication Engineering, Jan '59, 84 E Randolph St, Chicago 1.

When Is a Tolerance Just Right?

Describes method for establishing specifications evolved from statistical control techniques consisting of 3-step method, involving reduction of number of components contributing to excessive variations, equalizing points of manufacturing variances, evaluations and change of tolerances.

"When Is a Tolerance Just Right," Dorian Shainin, Rath & Strong Inc, SAE Journal, Feb '59, 485 Lexington Ave, New York 17.

Two on Statistics

"Theory of Extreme Values," by J Mandel, National Bureau of Standards, (ASTM Bulletin, Feb '59, 1916 Race St, Philadelphia 3) reviews basic concepts and results of this theory, particularly as it pertains to testing and the preparation of specifications.

"Should Statistical Methods Be Used to Prepare Material Specifications?", by Sheppard and Ginsburg, Westinghouse Electric Corp (also from ASTM Bulletin, Feb '59), consists of an analysis of some of the problems involved in this question. How statistical methods are applied, a discussion of risks, minimum average specification values are among subjects discussed.

Automatic Control Functions

The automotive cooling system thermostat is used to illustrate the basic concepts involved in application of automatic controls.

"A Qualitative Analysis of Automatic Control Functions," R V Fisher, General Motors Engineering Journal, March '59, PO Box 177, North End Sta, Detroit 2.

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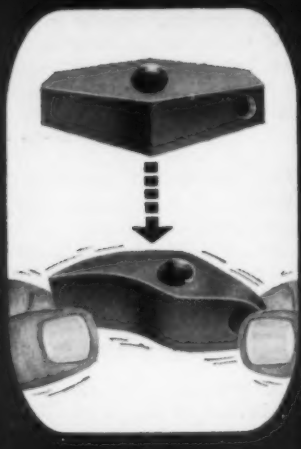

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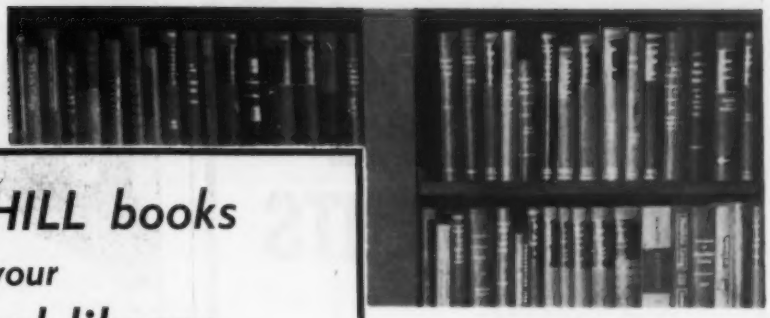

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NEW BOOKS

Drafting Standards–Plastics

American Drafting Standards Manual, ASA Y14.11-1958. Published by ASME, 29 W 39th St, New York 18. Paperbound, 8½ x 11, 22 pp. $1.50.

Because the mechanics of detailing and dimensioning plastic parts is generally the same as for other materials, this manual discusses only the peculiarities of designing parts to be made of plastic. It includes a brief run-down of the various materials and manufacturing processes, along with hints for designing parts with ribs, bosses, fillets, draft, flash lines, inserts.

Powder Metallurgy in Nuclear Engineering

Published by American Society for Metals, Cleveland. 6 x 9, 260 pp. $8.50.

Though it sticks closely to its major theme, nuclear engineering, and emphasizes such elements as thorium and beryllium, this book (a compilation of papers presented at an Oct 1955 conference, but since brought up to date) contains a good deal of information useful to the non-nuclear engineer. Especially valuable is the chapter on "New Methods," which gives a brief review of powder rolling, electrophoresis, and other important fabrication techniques. Also worth noting is a table giving properties of common ceramic materials like alumina and magnesia as well as the oxides and carbides of the more exotic metals.

Creep of Engineering Materials

IAIN FINNIE and WILLIAM R HELLER. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 36. 9 x 6, 341 pp, $11.50.

Here is comprehensive coverage of the creep of materials, treating design of creep conditions in thorough detail to aid in formulating and solving engineering problems. The book combines the basic principles of material behavior with important applications to engineering problems, and supplies clear perspective of the advantages and limitations of different materials which undergo creep.

You will find here fully detailed and illustrated treatment of such topics as: creep testing, measurement of creep variables such as temperature, strain, and load; mechanisms involved in the creep of metals and nonmetals; stress analysis under creep conditions; sources of creep data; factors in choosing a design stress; creep problems which occur in specific applications. In addition, typical creep curves are presented along with examples of engineering calculations.

Bringing together in a unified way the viewpoints of the physicist and engineer, the book should prove to be especially valuable to engineers and applied scientists contemplating a choice of materials for structural applications before the last stages of design.

A Vibration Manual for Engineers

Office of Technical Services, Dept of Commerce, Washington 25, D C 8 x 10, 30 pp. $1.

A handy manual containing formulas useful to design engineers in their efforts to minimize trouble from mechanical vibration. Included is discussion of equipment such as vibration generators, vibrographs, accelerometers, pallographs.

Tables of Modified Quotients of Bessel Functions

MARIO ONOE. Columbia University Press, 2960 Broadway, New York 27. 10½ x 8, 340 pp. $12.50.

Although there have been many studies of Bessel functions, little attention has been paid to modified quotients until recently. From a practical point of view, however, modified quotients are very useful because quotient forms of Bessel functions are encoun-

(Continued on page 93)

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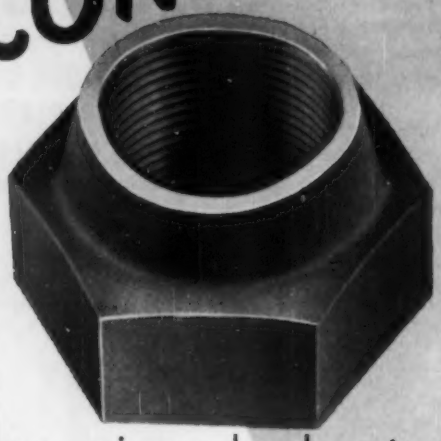

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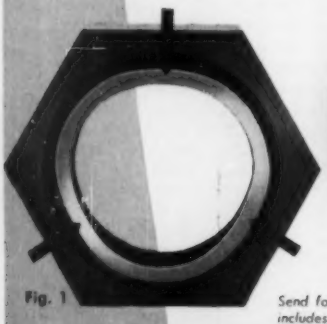

Fig. 1

Fig. 2

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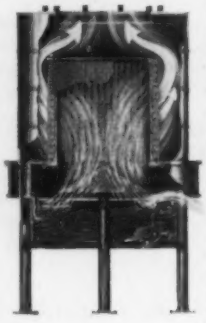

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EARLE BUCKINGHAM. Industrial Press, 93 Worth St, New York 13. 8½ x 11. $5.

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History of Mathematics, Vol. I and II

D E SMITH. Dover Publications Inc, 120 Broadway, New York 10. 5 x 8, 596 pp in Vol I and 725 pp in Vol II. $2.75 each.

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(Continued on page 94)

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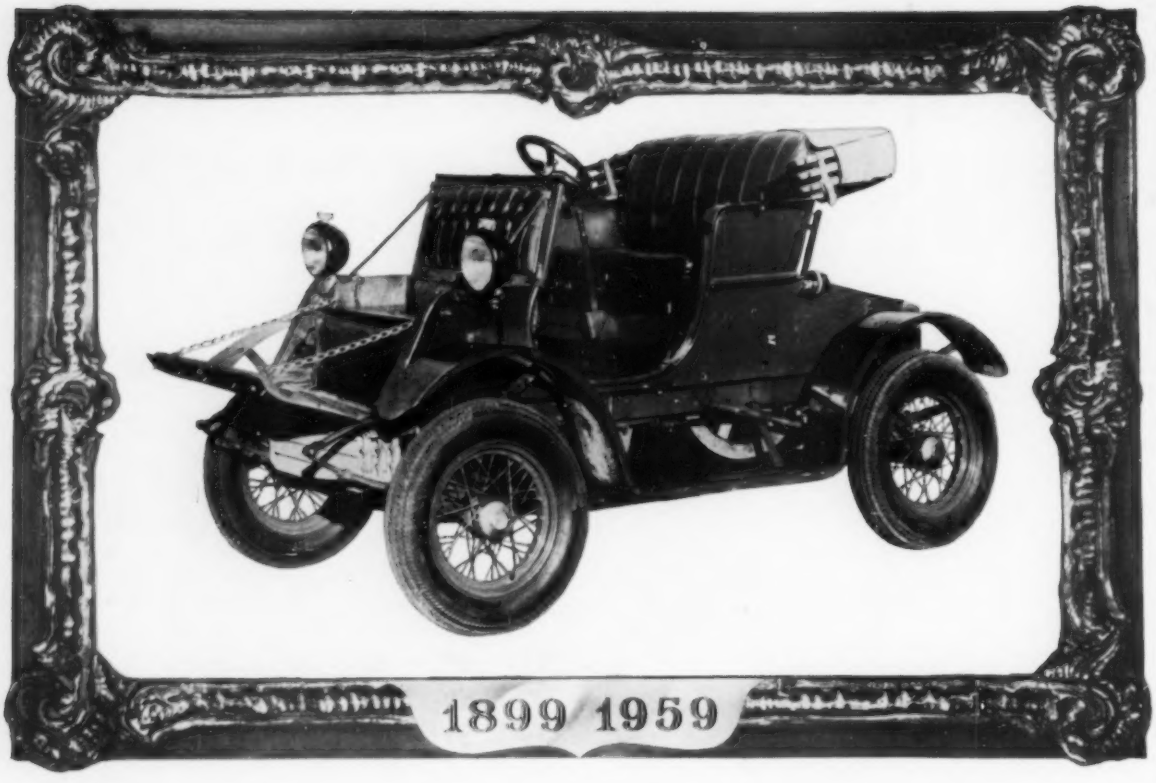

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